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ARTICLES

A LOW COST, LIGHT WEIGHT EXCAVATOR FOR DIGGING OR CLEANING MOSQUITO CONTROL DITCHES

THOMAS D. MULHERN
N. J. Agric. Expt. Station, New Brunswick, N. J.
AND
JAMES T. HART, JR.
Morris County Mosquito Extermination Commission

During 1947, the design of a new ditching machine was begun for the Morris County Mosquito Extermination Commission.

It was essential that the machine be simple and inexpensive to build for the funds available for this project were very limited. A design was therefore worked out that would permit the fabrication of the principal machine parts in metal working shops nearby, and the final assembly by the mechanics regularly employed by the mosquito commission.

The design also provided for the use of standard parts wherever possible, and that the completed machine be as light in weight as consistent with the service which was expected of it.

Since the machine was to be used only in fresh water swamps or in cleaning fresh water streams, and would have to dig only muck, sand, and relatively soft sod and alluvial soils, it was not necessary to provide for the excavation of rocky soils, stumps, roots, etc.

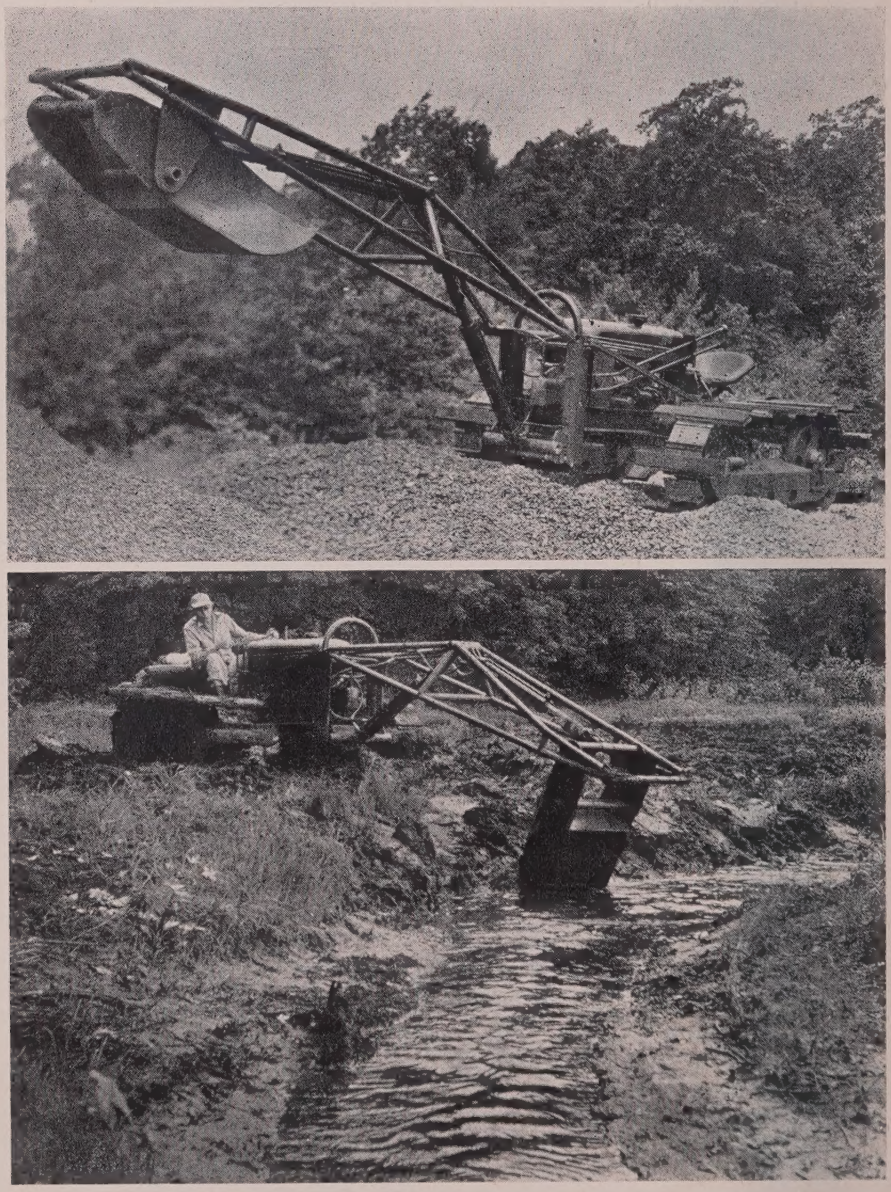
At an earlier date,[1] the Middlesex County Mosquito Extermination Commission had done considerable marsh ditch-cleaning using a slip scraper, chained hoe-fashion to the end of a boom mounted on the front end of a tractor. Consideration was first given to the construction of a duplicate of this machine, but it was finally decided that by the expenditure of a small additional sum, and substituting a trench shovel design, there could be constructed for one-man operation a much more efficient machine, providing complete hydraulic control of the position of the boom and the bucket, at the finger-tips of the operator.

Mode of Operation.—On new narrow ditches (22" minimum width for standard bucket) the crawlers may be operated astride the proposed ditch. The bucket is lowered to desired depth, and positioned with its cutting lip forward of center, to present a plow-like edge to the earth. Crawlers are engaged, the machine backs away from the work until the plow action fills the bucket. The bucket cylinder is then energized, the bucket brought to the "closed" position where there can be no loss of the load, the boom is raised, the tractor turned off the center-line of the ditch which swings the boom and bucket clear of the ditch line, where the spoil is dumped on the meadow surface.

For digging harder material, the boom is lowered with the bucket in open position. With the full weight of boom and bucket resting on the ditch bottom, and the crawlers stationery, the bucket is moved to the "closed" position, the arc described by its cutting edge having in this mode of operation considerably increased penetration power.

For use on wider ditches, the machine is operated on one bank, the center line of the machine being at approximately right angles to the center line of the stream. Both types of operation previously described may be used, but the bucket must always be partly or fully closed when passing over the ditch bank, to prevent loss of part of the useful load.

[1] Proceedings of 34th Annual Meeting N. J. M. E. A.—p. 148.



New "Hydraulic Ditching Hoe," now being tested by Mr. James T. Hart, Supt., Morris County Mosquito Extermination Commission, N. J. Designed by Thomas D. Mulhern, N. J. Agr. Expt. Station, ¼ cubic yard capacity.

The machine is easily operated, and none of the 3 persons who have used it had any previous experience with machines of this type.

Mechanical Features: Tractor.—Cletrac H6–68 crawler type tractor was selected because of its light weight (1½ tons) and its width, which allowed bolting on wood treads 24″ wide.

Boom Attachment Bracket.—Of welded steel construction, securely bolted through holes provided in tractor frame for fastening attachments. No additional holes had to be bored in the tractor.

Boom.—Of welded steel pipe, made in triangular sections for greatest strength with lightest weight, and is 10′ 6″ long.

Bucket.—3/16″ steel plate, welded construction, digging edge and bottom shape designed for easy penetration, and to allow full bucket to be drawn over ground sled-fashion to dumping point. Bucket capacity ¼ cubic yard.

Hydraulic Pump.—Vickers Power Pak, mounted to tractor main frame, forward of radiator, driven by extension shaft coupled to front end of tractor crank shaft. One 1-way and one 2-way valves provided to operate hydraulic cylinders at 750 pounds per square inch pressure.

Boom Operating Cylinder.—International Harvester 3″ x 28″ cylinder one way, for power raising and gravity lowering. Spacing of boom and cylinder is such that extending the cylinder to its full length raised the boom only to its highest *safe* position. Overcontrolling is thus impossible.

Bucket Operating Cylinder.—International Harvester 3″ x 28″ cylinder, used as 2-way cylinder, for opening and closing bucket.

Counterweights.—Steel frame at rear of machine is provided for attaching counterweights. A 1,000 pound counterweight is necessary to balance load of full ¼-yard bucket. When not using boom and bucket, counterweight tray may be used to carry sprayer, duster, or other attachments on the tractor, as the boom and hydraulic equipment can be detached by taking out 7 bolts and two hose connections.

Costs.—Present machinery cost less than $550 (exclusive of tractor, which cost $1,675, delivered September, 1947).

Proposed future developments.—It is proposed, as additional funds become available, to make two improvements: (1) To lengthen the crawler tracks at their forward ends, to reduce or eliminate the need for counterweights. (2) To add a device to provide for swinging the boom sidewise. This will reduce the amount of crawler travel, and add to the efficiency and life of the machine. Costs of increasing the track length and adding the swinging device will probably be less than $1,000.

Blue Prints.—Can be supplied at cost by T. D. Mulhern, N. J. Agricultural Experiment Station, New Brunswick, N. J.

ANNOUNCEMENT

THE 1949 ANNUAL MEETING
of the
NEW JERSEY MOSQUITO EXTERMINATION ASSOCIATION
will be held at
HOTEL HADDON HALL, ATLANTIC CITY, N. J.
March 22, 23, 24 and 25, 1949

YOU ARE CORDIALLY INVITED TO ATTEND

To be sure of receiving a copy of the program when printed, please write to Thomas D. Mulhern, Sec., N. J. Mosquito Exterm. Assn., New Brunswick, N. J.

ECOLOGICAL OBSERVATIONS ON THE MOSQUITOES OF CENTRAL ALASKA

DALE W. JENKINS
Medical Division, Army Chemical Center, Maryland

Increased military interest in the Arctic and subarctic regions has necessitated studies of the biting insect pests and their control. During the 1947 season, a study was started in the central Alaska area by the Alaska Insect Control Project. The project was supervised by B. V. Travis of the Orlando, Fla., laboratory of the U. S. Bureau of Entomology and Plant Quarantine and recommended by the Army Committee for Insect and Rodent Control. The ecological observations of the Biology Section on mosquitoes are presented for the period 5 May to 24 August 1947. The study was made in central Alaska from Anchorage to Fairbanks and Circle, and from there to Tok and Valdez along the highways and railroads. Special trips were made to Nome, Mt. McKinley National Park, and Adak in the Aleutian Islands. About 200 widely separated stations were established in different types of habitats, but the only intensively studied area was near Anchorage.

The collections and observations were made by the author and all other members of the project. The determinations were made or confirmed by Dr. Alan Stone, Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture. The ecological observations are preliminary and represent one season during which there was less rainfall than usual.

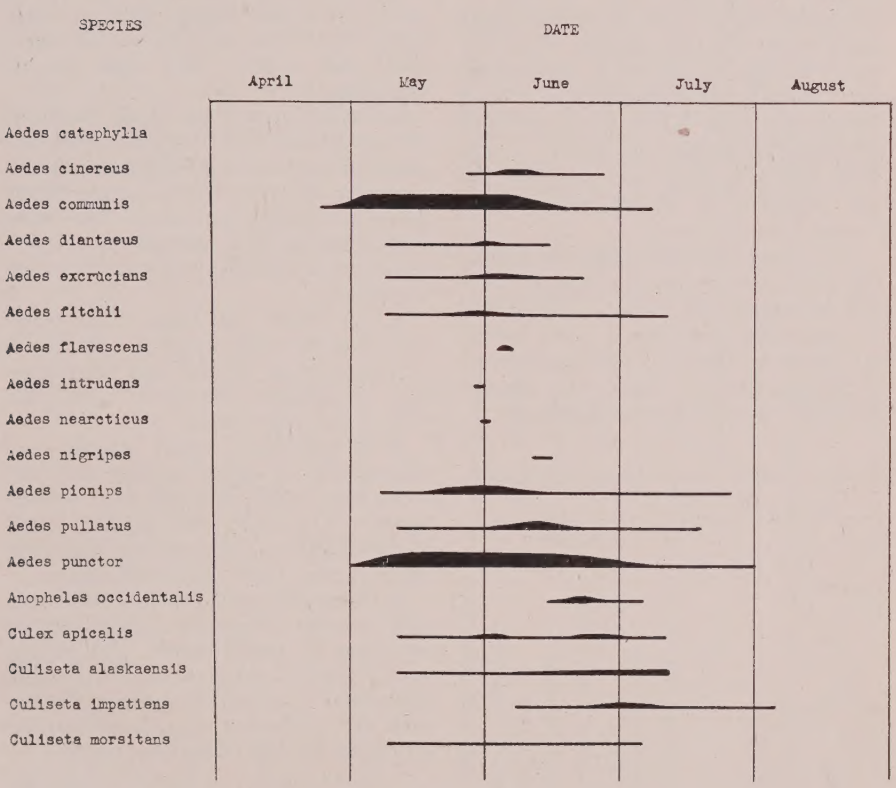
RESULTS

Eighteen species of mosquitoes were found in the central Alaska region in the 1947 season. The most abundant species were *Aedes punctor, A. communis, A. pionips, Culiseta alaskaensis* and *C. impatiens.* In the coastal marshes *A. flavescens* was locally abundant. Species that were fairly common and widespread were *A. diantaeus, A. excrucians, A. fitchii,* and *A. cinerus.* Species typical of the Arctic tundra extended south into the southern interior of Alaska only near the timberline in the mountain ranges, at elevations above 2,000 feet. These relatively rare northern species were *A. cataphylla, A. intrudens, A. nearcticus,* and *A. nigripes. A. pullatus,* which was not so rare, extended to sea level in the mountainous regions. Southern species that appeared to be near their northern limits of distribution were found near sea level and in larger river valleys. These species included *Culex apicalis, Culiseta morsitans,* and *Anopheles occidentalis.*

A somewhat indistinct succession of species took place throughout the larval breeding season and can be classified into four groups. The first group was composed of *Aedes communis* and *A. punctor,* which developed in very cold water. These species preceded or developed along with group 2, which was composed of *A. pionips, A. excrucians, A. fitchii, A. diantaeus, Culiseta morsitans, C. alaskaensis, Culex apicalis,* and perhaps *A. pullatus.* These appeared to require warmer temperatures and in some cases were found in habitats which did not thaw until later than those occupied by group 1. Group 3 was composed of the northern *A. intrudens, A. nearcticus, A. nigripes,* and probably *A. cataphylla* (larvae not found), which occur in the mountains. *A. cinereus* and the coastal salt marsh species *A. flavescens* were also in this group. The fourth group included *Culiseta impatiens* and *Anopheles occidentalis.* The exact dates of occurrence of each of the species of larvae and an indication of the relative abundance of each species are presented in Fig. 1.

It appears that with the *Aedes* there is only one brood each season. Larvae of *Anopheles, Culiseta,* and *Culex* matured throughout the last part of the season, but it is thought that only one brood was represented.

FIG. 1. Seasonal occurrence of mosquito larvae in Alaska, 1947



LARVAL HABITATS

The total area in which mosquitoes were produced was very extensive and widely distributed. The water in the breeding areas was derived in large part from melting snow, ice, and permafrost. The 1947 season was very dry, with a total rainfall of 1.61 inches in the Anchorage region during April–June. This was a deficit of 0.41 inches from the normal. The number of breeding places containing water was greatly reduced and many mosquito larvae died before finishing their development. Discoloration and turbidity due to suspended organic material increased in habitats in which the water was greatly reduced.

The water temperatures in early May varied from 33° to 48° F., and active larvae were found at the edge of or below ice ledges, in water temperature of 33°. The temperatures gradually increased in most habitats but remained low in seepage pools, bogs, and shaded areas underlaid with permafrost. Later in the summer, water temperatures were recorded as high as 71°, with averages as high as 68°. Some open shallow pools heated very rapidly, and the species succession was shortened. The species succession in very cold bogs rarely went past the early *Aedes punctor, A. communis* group.

The water in most habitats was rela-

tively acid early in the season with a pH of 6.0 or less. In late July and August, the pH of many habitats increased to over 7.2, and most of the waters tested were relatively alkaline. Unfortunately during the month of May, Nitrazine and Alkacid indicator papers were used in the field and these proved to be unreliable in testing cold water, so that these field pH values were discarded unless rechecked by phenol red or brom thymol blue indicators.

The many different kinds of habitat that produced mosquito larvae were classified into eight main types. The species of mosquitoes breeding in each habitat are shown in Table 1. The habitat types are briefly described below, with the predominant or characteristic vegetation.

TABLE 1. Larval habitats of Alaskan mosquitoes, 1947.

Species	Habitats							
	Climax spruce forest	Sphagnum-heath bog	Carex marsh	Myrica-Carex coastal marsh	Salt marsh (brackish)	Permanent pond	Excavations, wheel tracks	Snow melt, cold seepage pools
Aedes cataphylla								
Aedes cinereus		x	x					
Aedes communis	x	x	x	x	x		x	x
Aedes diantaeus		x	x					
Aedes excrucians		x	x	x			x	x
Aedes fitchii			x				x	
Aedes flavescens					x			
Aedes intrudens			x					x
Aedes nearcticus								x
Aedes nigripes								x
Aedes pionips			x				x	x
Aedes pullatus							x	x
Aedes punctor	x	x	x	x	x		x	x
Anopheles occidentalis						x		
Culex apicalis						x		
Culiseta alaskaensis			x	x		x		
Culiseta impatiens		x		x			x	
Culiseta morsitans			x			x		

1. Snow melt and cold seepage pools—includes the cold water in depressions and at the bases of snow banks, pools at the bases of cliffs, spring pools, and seepages. The water was clear, about neutral, cold, and usually with little or no vegetation.

2. Excavations, wheel tracks—includes all new artificial and natural depressions as gravel and borrow pits, roadside ditches, caterpillar and wheel tracks, recent oxbow lakes, and washed out places. The water was turbid to clear, variable in pH and temperature, usually with little or no vegetation.

3. Salt marsh (brackish). The water was clear to turbid, brackish, pH 7.0 to 7.8, temperature variable, and the vegetation *Triglochin maritima, Salicornia, Carex,* and other plants.

4. *Myrica-Carex* coastal marsh—area characteristic of coastal marshes, especially at the base of hills with cold fresh seepage water. The water was shallow, clear, slightly alkaline, cold, and the vegetation *Myrica gale, Carex* spp., and moss.

5. Permanent pond—pools usually deep, with variable temperature, often alkaline and clear to stained water. The vegetation included *Lemna minor, L. trisulca, Ranunculus purshii, Nymphaea, Utricularia,* etc., as floating aquatics and various emergent aquatics along the shore.

6. *Carex* marsh—an inclusive type containing areas populated predominantly with species of *Carex* and other plants as *Calamagrostis, Eriophorum, Equisetum,* etc. The water was usually shallow, clear, variable in pH and temperature.

7. Black spruce-sphagnum, heath bog—this includes all of the many and variable types of bogs. The important plants were *Picea mariana, Larix laricina, Betula glandulosa, Ledum groenlandicum, Andromeda polifolia, Potentilla fruticosa, P. palustre, Carex* spp. and *Sphagnum* spp. The bogs with permafrost near the surface usually had clear cold water, while the other bogs had dark-stained, often warmer water.

8. White spruce climax forest—the limited breeding places were holes and low

places containing cool water, clear to stained, with variable pH, often acid. The predominant vegetation was *Picea glauca, Betula papyrifera,* with many shrubs and herbs, often with a sphagnum ground cover.

The species associations of mosquito larvae are shown in Table 2. The numbers represent the number of times two species occurred together in the same habitat.

of mosquito larvae from May 16 to June 15. It occurred in the warmer habitats from Fairbanks to Anchorage and was most common in vernal temporary ponds containing *Carex* and other emergent vegetation. The algae were found on the gills of *Aedes fitchii, A. diantaeus, A. punctor, A. pionips,* and *A. excrucians,* and in some pools 10 per cent were found with algae. No observations were made on the effect of the algae on the mosquito

TABLE 2. Larval associations of Alaskan mosquitoes, 1947.

Species	Species																	
	Aedes cinereus	*Aedes communis*	*Aedes diantaeus*	*Aedes excrucians*	*Aedes fitchii*	*Aedes flavescens*	*Aedes intrudens*	*Aedes nearcticus*	*Aedes nigripes*	*Aedes pionips*	*Aedes pullatus*	*Aedes punctor*	*Anopheles occidentalis*	*Culex apicalis*	*Culiseta alaskaensis*	*Culiseta impatiens*	*Culiseta morsitans*
Aedes cinereus	x		4	2	2		1			1	1	5					5
Aedes communis		x	6	7	3		1			31	5	62		1	1		2
Aedes diantaeus			x	8	4		2			4	1	12					4
Aedes excrucians				x	8		2			5	3	17			2		3
Aedes fitchii					x					1		5					1
Aedes flavescens						x						1			1	1	
Aedes intrudens							x					3					
Aedes nearcticus								x				1					
Aedes nigripes									x		1	2					
Aedes pionips										x	4	35			1		2
Aedes pullatus											x	13		1	1		2
Aedes punctor												x	1	1	11	9	8
Anopheles occidentalis													x	3	3	1	
Culex apicalis														x	4	1	
Culiseta alaskaensis															x	12	3
Culiseta impatiens																x	2
Culiseta morsitans																	x

NATURAL CONTROL

The drying of the breeding places before adults emerged greatly reduced the mosquito population during this season. Predacious Chaoborinae were locally abundant and, of these, the genera *Mochlonyx* and *Chaoborus* were the most common. *Eucorethra underwoodi* was occasionally found. Other types of predacious insects were more common in the latter part of the breeding season.

A green alga was found on the gills larvae, and a number of affected larvae were observed to pupate normally.

A stalked protozoan, *Intranstylum invaginatum* (Stokes), of the order Peritricha was found on the larvae of *Aedes punctor.* These *Vorticella*-like protozoans were visible on the outside of the anal gills and on all parts of the larvae, especially on the sides and dorsal surface. They were white when alive and were easily seen on the larvae in the water. There were also many delicate filaments

of sulphur bacteria on the larvae. Larvae covered by the protozoans and bacteria were full-sized fourth instar but they moved more slowly than unaffected larvae. The final effect on the larvae was not determined. The protozoan was found on larvae in cold bogs in the Anchorage area in late July and early August. The water temperature of the bogs varied from 38° to 45° F.

NOTES ON SPECIES

Aedes cataphylla Dyar.—No larvae of this species were collected, but adults of what appeared to be this species were taken in an alpine meadow at 2,400 feet in Thompson Pass near Valdez, and in the tundra close to sea level at Nome.

Aedes cinereus Mg.—Larvae of this species were found from Circle to Anchorage at elevations under 1,800 feet in sphagnum-heath bogs, in *Carex* and grass marshes, and in the emergent vegetation at the margins of lakes, permanent pools and abandoned gold prospect holes. Only occasional specimens were collected in eight widely separated localities.

The adults were observed biting in a few well-forested localities.

Aedes communis (Deg.)—Larvae of this abundant species were found throughout the area studied from coastal areas at sea level to above timber line at elevations above 3,500 feet. They were found in bodies of water of all sizes and types, but were most abundant in shallow depressions, either open or shaded. The heaviest breeding areas, up to 300 per dip, were vernal ponds which dried up early in the summer. The larvae withstood sudden changes in the environment and were the easiest to rear in the laboratory. This species was one of the earliest to appear in the spring. Larvae were found active at water temperatures of 33° F. with permafrost below and a thin layer of surface ice above. The larvae were nearly always found in open water and did not hide in the vegetation.

Adults were quite common pests in wooded areas throughout the summer during the daytime, and they came into the open in the evening. A female that fed on a human laid 67 eggs, and dissection did not reveal any more in the ovaries.

Aedes diantaeus H. D. & K.—Larvae were collected from Fairbanks to Anchorage in 14 widely separated areas in open sphagnum-heath bogs, temporary vernal pools, depressions containing *Carex*, grass, or *Equisetum*, and at the margins of permanent pools. They were usually closely associated with submerged emergent vegetation. The water was usually acid, averaging pH 6.2.

Aedes excrucians (Walk.).—Larvae were collected in 24 widely separated places throughout the area but were never numerous. They occurred in *Carex* swamps, coastal marshes, grass marshes, and in many types of excavations. They were found in both temporary and semi-permanent pools but were most common in temporary vernal pools with a small amount of emergent vegetation. The habitats were nearly always open with little or no shade. The larvae were sometimes found in the same places as *A. fitchii* and had similar habits, although they did not swim as fast and were easier to dip.

Aedes fitchii (F. & Y.).—Larvae in small numbers were found in 11 different places from Fairbanks to Anchorage. They bred in open unshaded places such as excavations and borrow pits, with no vegetation or only early pioneer species, and temporary vernal ponds with a small amount of emergent vegetation, open *Carex* swamps and some grass marshes. The bottoms of the habitats were usually bare mud or gravel with little accumulation of organic debris. Most of the breeding places were shallow temporary pools filled with snow or ice melt or early spring rains. The larvae were difficult to catch, since they swam rapidly to the bottom when disturbed, and remained there for long periods of time.

Aedes flavescens (Muell.).—Larvae were found only in open and unshaded coastal flood plains near Anchorage. The characteristic vegetation in the breeding places was *Triglochin maritima* and some *Carex*. The water was shallow with scattered deeper holes, often brackish.

The adults were fairly common locally

in the open coastal marshes near Anchorage, but were not found in the woods or areas adjacent to these marshes. The biting rate of this species was seldom more than five per minute, but 20 per minute was observed on one occasion. Biting occurred throughout the day on warm, still days.

Aedes intrudens Dyar.—A northern and relatively rare species found near Fairbanks and in five localities at elevations of 1,600 to 2,800 feet. The typical habitat of this species was *Carex* swamps containing deep water, semi-permanent pools and the margins of small lakes.

Aedes nearcticus Dyar.—Larvae were collected only once in a pool at the base of a snow bank, at an elevation of 3,000 feet, in the Alaska range near Black Rapids. The main vegetation in the depression was *Carex, Salix reticulata,* and various small heaths and moss.

Aedes nigripes (Zett.).—This species was found only in two localities in the Alaska and Chugach mountains at above 2,400 feet. Larvae were found in clear water in a snow melt pool below a glacier and in an icy pool in an alpine meadow. No vegetation occurred in the glacial pool and a mat of dead *Carex* with a few willows was found in the other. There were fourth instar larvae in the middle of the pool and smaller ones near the edges.

Aedes pionips Dyar.—This was one of the most abundant and widespread species from sea level to about 3,000 feet. The larvae occurred in excavations, such as roadside ditches, gravel pits, blast holes, and seepage pools from gold mines. They were particularly abundant in the tracks made by caterpillar tractors and sleds which had been driven through bogs and spruce forests. About 60 areas were examined containing "cat" tracks made during the past 5 years, and most of these contained populations from about 10 up to 300 larvae per dip. Larvae were taken also in vernal ponds, depressions in bogs, in oxbow lakes, and pools under rock ledges. This species is a pioneer in new habitats. The breeding pools were usually temporary or semi-permanent and they varied in size from shallow moose tracks to extensive and deep ponds. The pools were shaded and unshaded, the amount of light not appearing to affect the populations. The larvae were disturbed readily and descended to the bottom rapidly where they wriggled along the bottom of the pool and remained for longer periods of time than usual.

Aedes pullatus (Coq.).—Alpine meadows above the timber line in the higher mountain passes appeared to be the most typical breeding places of *A. pullatus* in interior Alaska, but the larvae were found down to sea level. They were collected at 20 localities, mostly above 2,000 feet, and were found in snow melt pools, seepage areas, holes in stream beds, below a rock ledge and in other habitats. The populations averaged about 5 per dip, but up to 200 per dip were observed. The larvae occurred usually in clear water in small pools in open and unshaded locations. They were readily disturbed and descended to the bottom. The larger larvae were observed toward the center of the pool and the earlier instars in the shallower water at the margin.

Aedes punctor (Kirby).—This was the most abundant species of mosquito found in central Alaska. It occurred in nearly all localities studied and was locally abundant from sea level to 3,500 feet elevation. The characteristic larval habitats were those that remained cold during the season from subsurface permafrost ice. Larvae were collected most frequently in the black spruce-sphagnum moss-heath bogs and in the *Myrica* and *Carex* coastal marshes. They were also found in *Calamagrostis* marshes, snow melt and cold seepage pools, permanent pools, excavations and wheel tracks, and in white spruce-birch climax forests. Although this is an early spring species, it was found during June and July in depressions in cold bogs. The habitats were usually open and unshaded. In many places high populations of 100 to 300 larvae per dip were encountered. It was collected more than 180 times and was found associated at least once with each of the other species. Larvae were commonly found in brackish coastal marshes, some of which had an

odor of H_2S and contained a sulfur-like material. Many were encrusted with a whitish yellow substance similar to that deposited on objects in the bottom of the depressions. Larvae were active at 33° F. in water with permafrost ice below and thin surface ice above. They were often absent or uncommon in bogs that warmed up or dried out rapidly. The developmental period was quite long in many cases and larvae appeared to remain the same size for over a month in cold bogs. The larvae descended to the bottom of the pool when disturbed and often remained longer than *A. communis* larvae, with which they were frequently found.

The adults appeared in early June and became more abundant in July. They were abundant in the spruce woods during the daytime, but were commonly encountered in open areas in the evening. Biting occurred throughout the day and was heaviest from 6:00 p.m. to 11:00 p.m. Biting rates of 25 per minute of a mixed population of *Aedes punctor* and *A. communis* were found in a few areas and swarms of about 200 females were observed in a few places. Light breezes greatly reduced the biting rates and activity of the adults. Due to the difficulty of adult determinations, the observations of their behavior were limited.

Wild females collected after a blood meal were kept in glass tubes with moistened cellucotton and provided with a raisin for food. The first eggs were laid on the fifth day and the highest numbers were laid on the sixth day. The egg-laying records are given below for four females:

Eggs laid	Mature eggs dissected from female	Total
54	89	143
7	20	27
42	11	53
15	41	56

These females died before depositing all of the eggs. Thirty-three additional females which had not laid eggs were dissected, and they contained from 3 to 131 eggs, averaging 48.

Anopheles occidentalis D. & K.—These larvae were found in permanent pools, old ponds, and at the margins of lakes. They were always associated with floating or partly submerged plants, such as *Lemna minor, Lemna trisulca, Ranunculus purshii, Utricularia,* etc. The breeding places were usually unshaded. Larvae were collected in six widely distributed localities from Circle to Anchorage along the coast and near river valleys, never at higher altitudes. The populations rarely exceeded about one larva per dip. The water in which the larvae were found was clear and alkaline, ranging from 7.4 to 7.8. The temperature varied from 60° to 68° F.

On May 7 about 15 females were collected as they attempted to bite. Although this species was not very aggressive, biting was observed throughout the day until 10:00 p.m., and at temperatures as low as 44° F. Cast pupal skins were observed in July, but the only adults (about 30) were seen during the month of May.

Culex apicalis Adams.—Permanent pools and ponds containing vegetation, such as *Lemna* spp., *Ranunculus purshii, Scirpus validus,* etc., were the characteristic habitats for the larvae of this species. They were found in 10 localities from Fairbanks to Anchorage usually near sea level along the coast or in river valleys at comparatively low altitudes. The larvae were usually found among floating vegetation in the same habitats as *Anopheles occidentalis.* Overwintered females were observed resting on moist logs, stumps, and vegetation near small permanent ponds throughout the month of May. They made no attempt to bite humans. In the ponds where the females were observed a number of frogs *Rana cantabrigensis latiremis* were collected.

Culiseta alaskaensis (Lud.).—Larvae of this species were collected in 25 widespread localities from sea level to 2,500 feet. They were fairly abundant locally in *Carex* swamps, and in the *Carex* and grass at the edge of small pools and ponds. They were abundant in the small pools among *Carex* and *Myrica* in coastal marshes. Larvae were collected in a bog, in a permanent pond containing duckweed and in a small pool containing decaying logs. They were found in

shallow or deep pools and marshes of various sizes. The breeding places were usually open and unshaded. All instars of larvae were found from May 11 to July 10. The overwintered females were common and bit readily from the latter part of April until the middle of June. No males were collected in the spring. The adults became more abundant again in late July and August but did not bite much at that time. Biting was more common on the upper parts of the body, especially on darker areas of the skin and at the hair line. The females were most aggressive during the long crepuscular periods, although they would bite throughout the day. Biting was observed in winds of 10 miles per hour on the leeward side of subjects, and at air temperatures as low as 44° F. The adults were commonest in spruce woods, especially early in the season. They also occurred in open areas and could be found biting in almost any habitat, including the inside of buildings. Biting rates of 5 to 20 per minute were observed in a few localities. Egg rafts were observed as late as July 3.

Culiseta impatiens (Walk.).—Larvae were collected from 18 widespread localities from Circle to Anchorage and Valdez, and at sea level to 1,500 feet elevation, but adults were collected at higher altitudes. The larvae were taken in the same habitats as *C. alaskaensis* and, in addition, were found in muddy turbid water of road ruts and excavation ditches.

The habits of the adults were similar to those of *C. alaskaensis*. When they were found together *C. alaskaensis* was usually more common. The biting habits of the two species were similar, but *C. impatiens* appeared more nervous and did not bite as readily as *C. alaskaensis*. No high biting rates of this species were observed. The females were active and biting at 44° F. air temperature during the first week of May. No males were collected early in the season. A wild female which was caught and fed on human blood died without laying eggs. Dissection revealed 144 eggs which appeared well formed and nearly mature.

Culiseta morsitans (Theob.).—This mosquito was found only in the larval stage, in temporary *Carex* marshes, lake margins, coastal marshes, and in bogs. In all collections, *Carex* was found to be the most important vegetative type associated with this species. The larvae were always found in unshaded open, temporary or permanent clear water. The larvae were uncommon in collections, only 41 being collected, and 16 of these came from one pool. They were found among the *Carex* plants and were rarely seen at the surface.

Summary

A preliminary ecological survey of the mosquitoes of central Alaska was made during the period May through August, 1947.

Eighteen species of mosquitoes were found, of which *Aedes punctor, A. communis, A. pionips, Culiseta alaskaensis* and *C. impatiens* were the most abundant. An indistinct succession of species took place throughout the larval breeding season, and only one brood was observed for each species. The observed larval associations are presented.

The total area in which mosquitoes are produced is very extensive and includes many different types of habitat, with relatively low populations (this season) per unit area. This makes control operations difficult. The larval habitats were classified into eight main categories based upon kind of depression or pool, water source and type, and vegetation type. Most larval habitats were relatively cold and acid early in the season, but usually became warmer and often more alkaline.

Drying of breeding places due to the unusually dry season greatly reduced the mosquito population this season and curtailed adult studies. Predacious Chaoborinae were locally abundant, and a green alga was found on the gills of some mosquito larvae. A stalked *Vorticella*-like protozoan and filamentous sulfur bacteria were found on *Aedes punctor*.

Observations on the distribution, abundance, dates of breeding period, habitat, and other ecological data are presented for each species. Limited information on the habits of some adults is included.

ECOLOGICAL OBSERVATIONS ON THE BLACKFLIES AND PUNKIES OF CENTRAL ALASKA

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During the 1947 season, a study was made of the biting insects and their control in central Alaska by the Alaska Insect Control Project. This project was supervised by B. V. Travis of the Orlando, Fla., laboratory of the U. S. Bureau of Entomology and Plant Quarantine and recommended by the Army Committee for Insect and Rodent Control. The ecological observations of the Biology Section on blackflies and punkies are presented for the period 5 May to 24 August 1947. The study was made in central Alaska from Anchorage to Fairbanks and Circle, and from there to Tok and Valdez along the highways and railroads. Special trips were made to Nome, Mt. McKinley National Park, and Adak in the Aleutian Islands.

The collections and observations were made by the author and all other members of the project. The determinations were made or confirmed by Dr. Alan Stone, U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine. The ecological observations are preliminary and represent one season during which there was less rainfall than usual.

BLACKFLIES (Simuliidae)

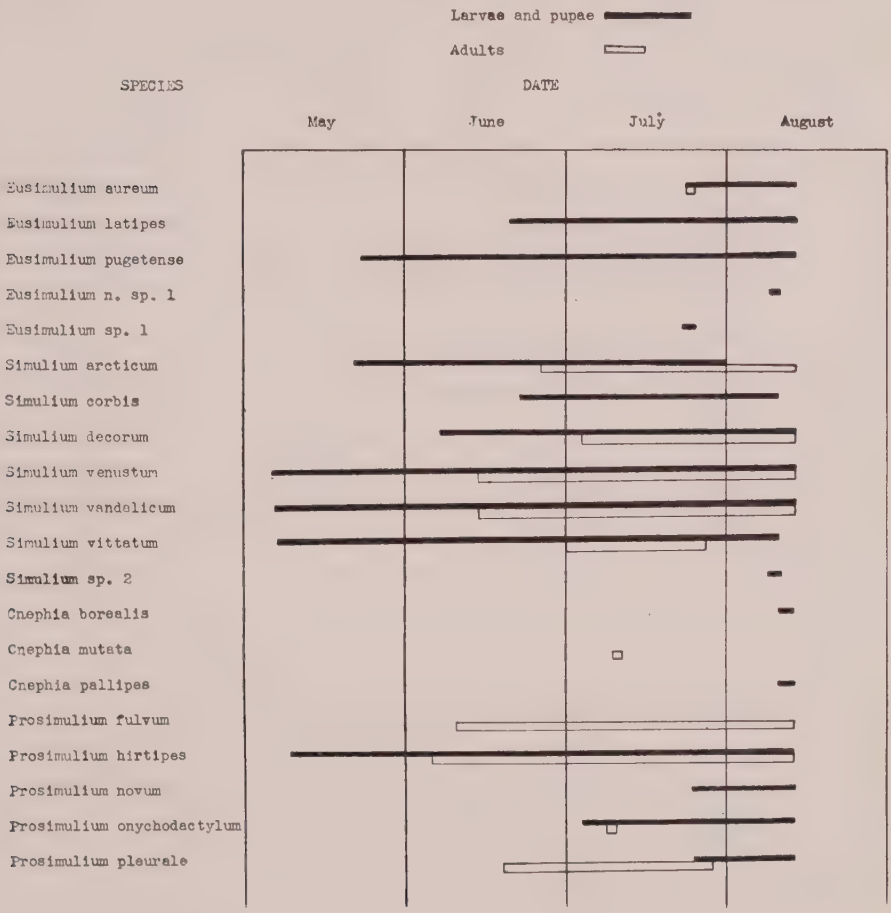
The species of Simuliidae locally known as "White-Sox" which were collected in central Alaska represent four genera and twenty species. Larvae and pupae of the genus *Eusimulium* were typically found in cold streams with a variable flow rate. *E. pugetense* was found in cold waterfalls and mountain streams, while *E. aureum* was in warm slow-moving water from lake outlets. The genus *Simulium* was typically collected in relatively warm slow-moving streams, often from lake outlets. The uncommon genus *Cnephia* was collected in cold streams. The species of *Prosimulium* were typically found in fast, tumbling mountain streams with clear cold water. The dates of collection of larvae, pupae, and adults of each species are presented in Fig. 1.

The largest populations occurred at the outlets below lakes where the under-water surfaces and vegetation were frequently black with larvae and pupae. Along one outlet stream a population was estimated at 100,000 *S. venustum* larvae per square foot. The associations of each species of larvae and pupae in the various stream habitats are shown in Table 1. The numbers represent the number of times two species were found in the same habitat and emphasize the specificity of each species to its typical habitat.

The adult populations were quite large in some localities and they were said to be important biting pests, especially along streams in the evening. Members of the project experienced few bites during the season. *Simulium venustum* and *Prosimulium hirtipes* were the only important biting pests observed.

The flow rates of streams were measured by timing the surface flow of a floating object. Flow rates are represented as slow (1–100), medium (100–200), and fast (200-plus feet per minute). Most of the streams are small, ranging from 1 to 20 feet in width, and from an inch to 12 inches deep. A few large rivers were examined but usually no black flies were found in them. The temperatures of the streams varied considerably throughout the season, but the water was generally cold. Temperatures ranged from 36° to 76° F., with averages ranging from 42° to 66° F. The oxygen determinations were made by the Winkler method. The population figures are estimates of the average number per square foot.

FIG. 1. Collection dates of blackflies in Alaska, 1947



NOTES ON SPECIES

1. *Eusimulium aureum* (Fries).—This species was found in five streams in the south central part of the area from near sea level to about 2,500 feet elevation. The streams were lake outlets, marsh and bog drainage streams with bottoms composed of sticks, wood and rock. Pupae were also found at the outlet of a beaver dam. The average water temperature was 56° F. and average pH 7.3.

2. *Eusimulium latipes* (Fries).—Locally common and widespread, this species was found most frequently at lower elevations from sea level to about 1,000 feet. Larvae and pupae were collected in 12 small shallow streams. They were common on wood and rocks, and were occasionally found on vegetation. Populations of this species were sometimes over 1,500 per square foot of surface, but the usual populations were about 50 per square foot. The average temperature was 52° F. and average pH 7.5.

Adults were observed in the field, especially at the streams where they were emerging.

3. *Eusimulium pugetense* D. & S.—

TABLE 1. Larval Associations of Alaskan Blackflies, 1947.

Species	*Eusimulium aureum*	*Eusimulium latipes*	*Eusimulium pugetense*	*Eusimulium n. sp. 1*	*Eusimulium sp. 1*	*Simulium arcticum*	*Simulium corbis*	*Simulium decorum*	*Simulium venustum*	*Simulium vandalicum*	*Simulium vittatum*	*Simulium sp. 2*	*Cnephia borealis*	*Cnephia pallipes*	*Prosimulium hirtipes*	*Prosimulium novum*	*Prosimulium onychodactylum*	*Prosimulium pleurale*
Eusimulium aureum	X		1					1	3	3	1							
Eusimulium latipes		X	5				2		6	6	1		1	1	1		3	
Eusimulium pugetense			X		1				3	3			3	3	10	3	5	3
Eusimulium n. sp. 1				X					1	1		1						
Eusimulium sp. 1					X				1	1					1		1	
Simulium arcticum						X			1	1	1							
Simulium corbis							X		3	3	1		1	1			1	1
Simulium decorum								X	2	2	1							
Simulium venustum									X	X	9	1	2	2	3		3	3
Simulium vandalicum										X	9	1	2	2	3		3	3
Simulium vittatum											X						1	
Simulium sp. 2												X			2	2	1	2
Cnephia borealis													X		2	2	1	2
Cnephia pallipes														X	2	2	1	2
Prosimulium hirtipes															X	8	8	4
Prosimulium novum																X		2
Prosimulium onychodactylum																	X	1
Prosimulium pleurale																		X

This widespread and not uncommon species was found in 16 streams at altitudes from near sea level to about 3,000 feet elevation. Typical habitats of this species were cold mountain streams, bases of waterfalls, and cold bog drainage streams. The bottoms of the streams and waterfalls were composed of rocks and slabs of schist and gneiss. The populations were low, seldom more than 5 larvae and pupae per square foot of rock surface. The larvae and pupae were found singly and not clustered. The average temperature was 42° F. and average pH 7.3.

4. *Eusimulium* new species 1.—Pupae collected in Caribou Creek at the 82 milepost near Nabesna.

5. *Eusimulium* species 1.—This species was collected only near Lowe River about 16 miles from Valdez at an elevation of 600 feet. Three larvae and three pupae were found on bare rock cliffs covered with brown-colored algae. The water flowing over the cliff face in a thin film was clear and cold.

6. *Simulium arcticum* D. & S.—This species was found in two streams, a lake outlet, and a bog drainage stream, in coastal areas below 500 feet elevation near Anchorage and Palmer. The larvae and pupae were estimated at about two per square foot on rocks and up to over 1,000 per square foot on wood. The average temperature was 51° F. and average pH 8.0.

An adult female was collected in the Chugach Mountains at an elevation of 4,000 feet.

7. *Simulium corbis* Twinn.—This relatively rare but widespread species was found in four streams along the coast and in the interior near Slana and Tok up to an elevation of 2,000 feet. The streams were bog and marsh drainage type in level and mountainous country. The populations were small, only one pupa being

collected in each of the stations. The water temperatures were from 45.5° to 52.5° F. and the pH 7.5.

8. *Simulium decorum* Walk.—This species was widespread and not uncommon in adult collections, but larvae and pupae were found in only three streams at Bear Lake, Sourdough, and Slana at elevations below 1,000 feet. The streams were lake outlets and bog drainage types. The larvae and pupae were found also at the base of small waterfalls at the end of culverts in two localities. At Bear Lake the larvae and pupae were found in large numbers on the rocks and were compacted into thick masses about ¾ inch deep. Two distinct larval development periods were observed. The dark stained water averaged 62° F. and pH 7.5.

9. *Simulium venustum* Say.—This widespread species was collected in 24 relatively slow streams from Circle and Fairbanks to Anchorage at altitudes from sea level to 2,000 feet. The streams were lake outlets or drains from marshes and bogs. In one stream the dissolved oxygen ranged from 7.0 to 9.0 p.p.m. and averaged 8.5 p.p.m. The total alkalinity composed mainly of bicarbonates ranged from 100 to 120 p.p.m. and averaged 110 p.p.m. This species was the most abundant black fly in Alaska. Populations of over 1,000 larvae and pupae per square foot of bottom surface were observed at lake outlets. One estimate of 100,000 larvae per square foot was based on sample counts of vegetation. The water was usually stained and averaged 59° F. and pH 7.6.

Two definite generations were observed, and it is possible that three distinct broods developed, at least in a few favorable localities.

10. *Simulium vandalicum* D. & S.—Same data as *S. venustum* but less common.

11. *Simulium vittatum* Zett.—This species was found in six relatively slow streams in the southern part of the central Alaska region, especially in the coastal region under 1,000 feet elevation. The streams were typical lake outlets with beds composed of rocks, logs, sticks, and occasionally some vegetation and sand. The dissolved oxygen averaged 8.5 p.p.m. and ranged from 7.0 to 9.0 p.p.m. The total alkalinity composed mainly of bicarbonates ranged from 100 to 120 p.p.m. and averaged 110 p.p.m. in one stream. The populations of larvae and pupae were abundant locally. At the height of a developing generation the populations were sometimes 1,500 or more per square foot of rock or wood surface. The water temperatures averaged 66° F. and the pH averaged 8.2.

Two distinct generations of larvae and pupae were observed to develop and a third brood was noted in some places which might develop to adults or overwinter in the larval stage. Adults of this species were collected in Adak in the Aleutian Islands on August 3.

12. *Simulium* species 2.—This undetermined species was found in Caribou Creek at the 82 milepost near Nabesna. The water was fast and clear.

13. *Cnephia borealis* (Mall.).—Collected from Valdez to Tok in three streams similar in type to those of *C. pallipes*.

14. *Cnephia mutata* (Mall.).—A single adult female was collected in a bog area near sea level at Pigot Bay. The specimen was collected when it alighted on the observer along with large numbers of *P. hirtipes* at about 6:00 p.m. in an area shaded from direct sunlight.

15. *Cnephia pallipes* (Fries).—This was a northern species found in four streams from Circle to Tok and Slana and was also collected at 3,000 feet elevation in the Sheep Mountains. The streams were mountain and bog drainage type with rocky bottoms. The populations averaged about 3 larvae and pupae per square foot of rock surface.

16. *Prosimulium fulvum* (Coq.).—Adults of this species were fairly widely distributed throughout the region and were most common in the southern part of the area, especially along the coast. The adults were collected from sea level to altitudes of 3,000 or more feet, but larvae and pupae were not discovered despite searches in streams near where the adults were found. Swarms of 25 or more females were observed flying

around humans. They often landed on the head and face, rarely on the lower part of the body. They were attracted to the skin, and occasionally probed, but there were no substantiated records of bites. The females were nervous when approaching a human and did not land readily. They were present in small numbers throughout the day, but were most common and active early in the morning and late in the evening. They were also collected by sweeping the vegetation with an insect net.

17. *Prosimulium hirtipes* (Fries).—This species was commonly found in cold, fast mountain streams and some cold bog drainage streams from near sea level to elevations of 4,000 feet. Larvae and pupae were collected in 37 widely distributed streams. This species extended higher in the mountains than other blackflies, and at high altitudes, while uncommon, was the only species present. The average population in the streams was about 15 larvae and pupae per square foot of rock surface. They were often found on the lower side of rocks, but also occurred on wood. The pupae were single or sometimes clumped, often with sand or dirt adhering to the loose pupal fibers. The average temperature was 43° F. and average pH 7.2. The developmental period was relatively long and only one generation was observed to develop, although two somewhat distinct flights of adults appeared. Swarms of about 100 adults were observed flying around persons and landing rates of 20 per minute were counted. The upper part of the body was the most subject to attack and the bite was painful, causing swelling and redness on some people. The adults were found biting at all hours of the day, but were more active after 5:00 p.m. and became most numerous late in the evening. They were also found in buildings and open areas where they were bothersome pests.

18. *Prosimulium novum* D. & S.—This species was collected in the northern part of the area, and in the Sheep Mountains at an elevation of 3,000 feet. It was found in 18 fast cold streams. The populations averaged about five larvae and pupae per square foot of rock surface. These were most commonly found on the under sides of rocks. The temperature averaged 41° F., and pH 7.4.

19. *Prosimulium onychodactylum* D. & S.—This widely distributed species was found in 11 clear mountain and bog drainage streams and waterfalls at elevations from near sea level to 1,000 feet. The larvae and pupae were commonly found on rocks and gravel, especially light-colored rocks with cracks and rough surfaces. The pupae were usually found separate from other species. Several pupae were sometimes clumped together, often with fine sand or dirt entangled in the loose pupal strands. The populations averaged about five larvae and pupae per square foot of rock surface. Nearly 300 larvae and pupae were collected, but the pupae were difficult to rear in the laboratory, and only one male and one female were reared. The average of stream temperatures was 45° F., and pH 7.4.

No adults were observed in the field except one male emerging from the pupal case in the water.

20. *Prosimulium pleurale* Mall.—This is a northern species found in the region around Circle and south in the Alaska Range to Tok and Slana. It was absent in all collections in the southern part of the area even at high altitudes. The larvae and pupae were collected in 11 fast clear streams at altitudes of 800 and 2,000 feet. The streams were mountain and bog drainage type with bottoms composed of rocks and boulders. The population averaged about eight larvae and pupae per square foot of rock surface.

Adults of this species were collected from three localities in the interior at altitudes of 500 to 1,000 feet. They were attracted to humans but the biting habits were not observed.

PUNKIES (Heleidae)

The genus *Culicoides* includes the small biting midges commonly known as "punkies" or "no-see-ums" in the north woods of the United States and Canada. In Alaska they are usually called "no-see-ums" or "moose-flies." They are called

"sand-flies" along the coast in the southern United States and in some tropical regions.

The biology of the punkies has not been studied in Arctic areas and very little is known of their taxonomy, distribution or habits. In the present study, eight species were found of which three, *C. obsoletus, C. yukonensis,* and *C. tristriatulus,* were abundant and were important pests.

The females were collected as they came to bite on the hands, face, and clothes of the observer. In an attempt to make a comparative approximation of the abundance of the different species, counts of the landing and biting rate per minute were made. While these rates were only approximations of the populations, they were useful for comparison.

The adults were not important pests until relatively late in the season in central Alaska. They were first observed biting about the middle of June and increased in numbers and species after this date. The dates of biting and collecting records for the adults are shown in Table 2. The females were found biting at all hours of the day from 6:00 a.m. to 11 p.m. In early July the maximum activity occurred after 8:00 p.m., and adults were bothersome until 11:00 p.m. This peak of activity was correlated with a decrease in air movement, temperature, and light, and an increase in relative humidity. The biting habits were unpredictable and somewhat variable, sometimes lasting for only a short period. In a given station, adults would be very abundant on one evening, while on the following evening at exactly the same time none would appear, especially if there was a light breeze.

TABLE 2. Collection dates for adult *Culicoides* in Alaska, 1947.

Species	Date			
	June	July	August	Sept.
C. tristriatulus				
C. obsoletus				
C. yukonensis				
C. sordidellus				
C. biguttatus		—		
C. species 1	—			
C. species 2	—			
C. species 3	—			

Other genera of the family Heleidae to which *Culicoides* belongs were also collected. These genera were *Dasyhelea* and *Atrichopogon* which were collected from the clothing, but bites were not observed.

NOTES ON SPECIES

1. *Culicoides obsoletus* (Meigen). — This species was the most abundant and widely distributed. It was common at lower altitudes and was found locally abundant along the coast as well as in several localities in the interior up to 1,000 feet elevation. They were observed biting more frequently in woods or nearby wooded areas, especially in the daytime, but in the evening were also found biting in open areas. Adults were locally abundant in *Carex* marshes along the coast, and were commonly found near habitations, but they were not observed to be troublesome pests in buildings. The females were observed biting from 8:00 a.m. to 11:00 p.m., but relatively few bit during the day. Landing rates of over 20 per minute were observed several times. They landed on all parts of the body and readily bit the exposed skin.

2. *Culicoides yukonensis* Hoffman. — This was the most widely distributed no-see-um of the interior where it was locally abundant. It was usually absent or very rare in the coastal areas. The adults were found from near sea level to an elevation of about 2,000 feet. They were frequently found in larger stream valleys, including the Yukon River at Circle. Open bogs and *Carex* marshes were the usual habitats in which the adults were most frequently encountered. They were also found biting in spruce forests and at the edges of woods in open fields. They were not common around habitations unless these were located in bogs or marsh areas. Biting occurred throughout the day to a limited extent, but large numbers were noticed only in the evening and for a relatively short period of time on favorable evenings when there was little or no

breeze. From 5:45 p.m. to 7:30 p.m. a large population was active and biting in the Gulkana area in an extensive open bog. Landing rates of over 100 females per minute on one leg from ankle to knee were counted. All parts of the body were attacked but the lower part of the body was attacked more, especially if there was a slight breeze.

3. *Culicoides tristriatulus* Hoffman.—Along the coast this species was very abundant locally, and small clouds were formed when the females swarmed around a person. It was restricted to the coastal region.

The largest populations were found on the tide flats and salt grass marshes along the coast. They were also found in bogs, open fields, and in sitka spruce-hemlock forests but in smaller numbers. The females were found in almost any habitat in the evening and were noticed around army camps and habitations. They were observed as far as 2 miles inland from the coast and were biting when collected over 2 miles at sea on a boat.

Adults were observed to bite in the morning from 6:00 to 10:00 a.m. in moderate numbers and to be very limited in activity during the day, when only a few bites were observed in wooded areas and in tall coastal vegetation. The greatest activity occurred in the evening from 6:00 to 10:30 p.m., with a maximum of biting from 7:00 to 8:30 p.m. Biting and landing rates of 20 per minute were observed several times, and in the swarms the rate was much higher. Up to 50 adults per square inch were counted on hats. The biting period extended over a longer period in the evening than observed for *C. yukonensis,* and a few were collected while biting after dark. All parts of the body were attacked, but the largest numbers were observed around the head and a hat was the best place to collect the specimens.

4. *Culicoides biguttatus* (Coq.).—One specimen of this species was collected as it alighted on the forehead of a man about 2:00 p.m. near Eklutna Lake. The habitat was a small bog near a stream and the area was open and unshaded.

5. *Culicoides sordidellus* (Zett.).—This species was collected as it attempted to bite man near Pigot Bay, Alaska, at about 6:00 p.m. in a sitka spruce-hemlock forest.

6. *Culicoides* species 1.—This species was collected in two localities along the coast in the Anchorage area. Females were collected in a spruce woods, in a nearby abandoned field with scattered trees, and at the border of a salt marsh. Biting occurred only from 8:00 p.m. to 11:00 p.m., and none were collected throughout the day.

7. *Cullicoides* species 2.—A single female was collected as it alighted on an observer in the Anchorage area about 1 mile from the coast. It was taken about 9:00 p.m. in an abandoned field with scattered trees near a spruce-birch forest.

8. *Culicoides* species 3.—Three specimens were collected as they alighted on an observer near the coast in the Anchorage area. They were taken about 9:00 p.m. in an abandoned field with scattered trees near a spruce-birch forest, at an altitude of 150 feet.

SUMMARY

An ecological study of the blackflies Simuliidae and punkies *Culicoides* of central Alaska was made by the Alaska Insect Control Project from May to August, 1947.

Four genera including twenty species of blackflies ("white-sox") were collected of which *Simulium venustum* and *Prosimulium hirtipes* were the only important biting species. Blackflies were not observed to be very troublesome pests this season and few bites were experienced.

Eight species of *Culicoides* ("no-see-ums") or ("moose-flies") were collected of which three, *C. obsoletus, C. yukonensis,* and *C. tristriatulus* were abundant biting pests.

The distribution, habitats, abundance, and biting habits of these insects were observed in relation to control operations. The observations are preliminary and represent one season during which there was less rainfall than usual.

NOTES ON THE BIOLOGY AND CONTROL OF MOSQUITOES AT UMIAT, ALASKA

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Introduction

In northern Alaska the spring thaw is followed by a sudden emergence of swarms of mosquitoes and other biting insects which persist until the first freeze. Since the insect season coincides with the period of greatest human activity, work is handicapped by the presence of these insect pests. Therefore, studies on the biology of Arctic mosquitoes and attempts to control them were made at the camp at Umiat, Alaska, during the summer of 1947.

Location and Topography

Umiat, Alaska, is situated at 69° 24′ North latitude, 152° 8′ West longitude on the north bank of the Colville River. It is approximately 175 miles southeast of Point Barrow and 181 miles north of the Arctic Circle (Fig. 1). This region, known to the geologists as the Arctic Plateaus of Alaska, is characterized by relatively smooth uplands dissected by stream valleys. From a distance the area appears as a high plain, but nearby it is seen as a succession of gently rolling hills interrupted by moderately deep valleys.[1] The Colville River Valley, oriented east and west at Umiat, is approximately four and one-half miles wide with bluffs on either side rising rather abruptly to an average elevation of 500 feet above the river. Several small streams of which Seabee and Bearpaw Creeks are the more important, have cut side valleys in the bluffs on the north near Umiat.

The Colville River has several channels. Consequently, many islands and bars have been formed. The principal channel of the river shifts from the south to the north side of the valley at Umiat. Numerous sloughs and lakes found on the valley floor are evidence that the river has changed its channels many times. A succession of changes in these sloughs can easily be recognized. Some are still an active part of the river. Others are separated from it by sand or gravel bars except during high water following the thaw. Still others remain only as elongated marshy areas with deep pools and lakes dotted along their former course. Three terraces to the north of the river channel at Umiat mark the gradual lowering of the valley by erosion. The present elevation of the river is approximately 350 feet.

Most of the sloughs, creeks, and the river are lined with thickets of scrubby alders and willows. Near Umiat these trees range up to ten feet in height. Between the sloughs, the tundra is characterized by a luxuriant growth of mosses, lichens, and grasses, and later in the summer by numerous wild flowers. The grasses are predominant and grow in clumps which form hummocks or "niggerheads." Because the water table is forced to the surface by perma-frost which never thaws deeper than three feet at Umiat, pools and ponds lined with moss are formed in nearly every depression in the tundra. Some are merely very small pockets of water present between the "niggerheads." These pockets occur not only on the valley floor but on the gentler slopes of the hills as well. In many places the valley floor has been cracked

FIG. 1. Location of Umiat, Alaska.

by frost action into huge polygons (usually hexagons). The cracks resemble small ditches and are filled with water up to a depth of six inches.

WEATHER DATA

A knowledge of the weather conditions in the area under study is indispensable in mosquito control work, especially in the Arctic. The disappearance of snow in the spring marks the beginning of larval development. Subsequent air and water temperatures regulate the growth rate of both larvae and pupae, and influence the behavior of the adults. The prevailing wind directions must be known in order to define the area in which mosquito control is desired. The daily wind velocities, maximum and minimum, as well as the maximum and minimum temperatures are essential in planning spraying operations. Therefore, it is necessary to discuss briefly the weather at Umiat during the mosquito months (June, July, and August). However, this discussion is limited to the years 1945 through 1947, since only these records were available.

The last inch of snow at the Umiat weather station melted on 25 May in the 1947 season. Drifts, of course, melted more slowly. Some were present on the valley floor until 9 June while those on the river bluffs persisted until mid-July. In 1946 snow disappeared on 4 June when the last three inches melted overnight. The thaw was later in 1945 for

there were still traces of snow in the valley until 30 June, although most of it had disappeared by 6 June.

Although the sun shines for most of the 24-hour period during the mosquito months, except when obscured by clouds or fog, the daily temperatures show a definite rise and fall. Daily temperature curves follow essentially the same pattern with the maximum usually occurring between 1400 and 1600 and the minimum between 0200 and 0400. The daily temperature fluctuations may exceed 30° F. and are usually greater than 15° F. During most of May the daily maximum temperatures gradually increase until by early June they are almost constantly above freezing. In June the maximum may reach 71° F. and in July may soar to 82° F. Early in August the maximum temperatures begin to decline, and in September they are usually down to freezing again. The daily minimum temperatures may fall below 32° F. almost any time during the summer, although freezing weather is not common in July and early August. Lowest temperatures usually occur between 0200 and 0400 and often accompany ground fog or heavy clouds. The frost-free season is very short. In 1945 it lasted from 22 June to 7 August; in 1946 from 3 June to 18 July; and in 1947 from 30 June to 8 August. The average length of this season is 42 days.

Wind velocities are extremely variable. Winds exceeding ten miles per hour occur more frequently than those with velocities of less than five miles per hour. During a 24-hour period the wind may vary from 23 miles per hour to dead calm (25 June 1945). On 17 August 1946 calm conditions prevailed for ten hours, but winds of 15 miles per hour were also recorded on the same day. The daily maximum wind velocities usually exceed ten miles per hour while the minimum is frequently greater than three miles per hour. In sharp contrast to the variable wind velocities are the consistent wind directions. During the months of June 1945 through 1947 winds blew along an east-west axis for 42 of the 89 days (one record was missing). With prevailing winds from the northeast on 24 days, all other directions accounted for only 21 days. In June 1947 winds from the east and northeast occurred on 28 of the 30 days. Winds are more variable in July and August. The prevailing directions gradually shift from the east and northeast to the west and southwest. Winds from the northwest and southeast are uncommon for they prevailed on only 15 of the 275 days during the mosquito months (June, July, and August) of 1945 through 1947 (Fig. 2).

Rainfall usually occurs as light showers during the summer months. However, on 19 August 1947, 1.03 inches of rain fell in a 24-hour period. Ground fogs, moving into the valley from the north or northeast, force the relative humidity to the saturation point but do not produce measurable precipitation. When the temperature is below 36° F., snow flurries may occur even in July.

Laboratory and Field Data on Mosquitoes

The initial problem in 1947 was to determine as accurately as possible the extent and sites of mosquito breeding. The discussion of topography has indicated that abundant water surfaces occurred everywhere throughout the area. Therefore, it was necessary to check as much of the standing water as possible to determine the actual sites in which mosquito larvae were developing. On 28 May, there was begun a rather complete survey of the waters in an area of approximately six square miles bounded by the bluffs north of Umiat, the Colville River on the east and south, and an arbitrary line drawn between the bluffs and the river on the west.

Larval habitats.—The larger bodies of water subjected to continuous wind, wave or current action (Figs. 3, 4, 5) and the small pockets of water between hummocks contained no larvae. Sites from which mosquito larvae were collected can be classified into the following four main types: grassy sloughs, mossy pools, frost ditches, and willow-alder pools. A species

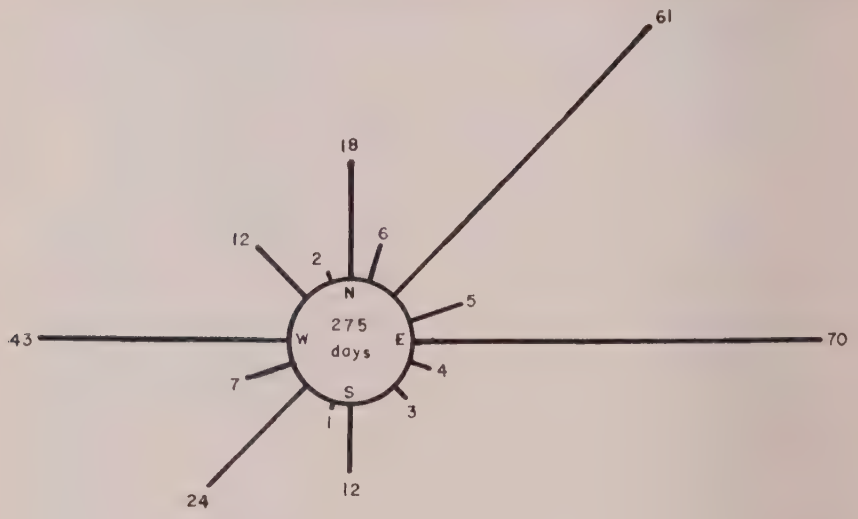

FIG. 2. Summary of the daily prevailing wind directions during the mosquito months 1945 through 1947.

TABLE 1. Summary of larval habitat data, Umiat, Alaska, in 1947.

Species of *Aedes*	Number of collections from each type of habitat					Associated species
	Grassy slough	Moss pools	Frost ditch	Willow, alder pools	Total	
A. punctor	18	11	1	0	30	*A. communis* (5 coll.) *A. nearcticus* (4 coll.)
A. communis	5	0	2	2	9	*A. punctor* (5 coll.) *A. nearcticus* (1 coll.)
A. nearcticus	0	7	0	2	9	*A. punctor* (4 coll.) *A. communis* (1 coll.)

selectivity for these habitats was observed (Table 1). A detailed description of each habitat is given below.

a. Grassy sloughs.—These sloughs (Fig. 6), which previously have been described under topography, and which were most numerous on the first two terraces, formed a very high percentage of the total water surface in the valley. They ranged from lakes and ponds with relatively little marginal emergent grass to extensive marshes completely overgrown with grass. Larvae usually could be found in the sloughs wherever the water was protected from

FIG. 3. Current and wind action prevented mosquito breeding in the marshes and open waters along creeks.

FIG. 4. Marshes and open waters of larger ponds and lakes had no larvae because of wind and wave action.

FIG. 5. Man-made ditches and ponds two years old were not breeding sites.

FIG. 6. *Aedes punctor* and *A. communis* larvae were found in grassy sloughs.

FIG. 7. *A. punctor* and *A. communis* larvae occurred in frost ditches. The width of the ditch may be judged by the dipper in the foreground.

FIG. 8. *A. communis* and *A. nearcticus* larvae were present in willow-alder pools. This particular pool, larger than usual, was in a well-protected location and contained *A. communis* larvae only.

wind action. However, as the season advanced and the water in some of the sloughs was reduced to small pools at the lowest points, larvae were concentrated in the open waters. They were found in water depths ranging from 1 to 12 inches. The bottoms of the slough breeding areas consisted of muck, covered with variable amounts of decaying vegetable matter. In almost all cases, breeding was associated with abundant numbers of copepods, snails, water mites, and diving beetles. Frequently larvae of other insects, such as *Dixa* and *Mochlonyx,* also were present.

Toward the end of the larval developmental period, many of the drying areas developed not only biological surface films but also copious amounts of dark brown scum on all underwater surfaces. In such places, the larvae usually also were coated with this material. At this time some larvae were found with a filamentous green alga growing on their bodies, particularly on the anal gills. Neither the scum nor the alga seemed injurious to the mosquitoes. Until mid-summer the emergent grass, which is the dominant floral characteristic of the sloughs, consisted of dead plants of the previous year. These stems and leaves seldom emerged more than 12 inches above the surface. Occasionally, the emergent stems had fallen onto the surface. New grass growth was first observed above the water surface late in June.

b. Mossy pools.—All larval collections from this habitat type were from second and third terrace levels. Probably the typical "tundra pools" of other authors, these pools were small (one to ten feet in diameter), shallow (usually two to eight inches in depth) and very clear, with mossy sides and bottoms. A few emergent grass stems were sometimes present. Snails were absent, and copepods scarce. Diving beetles occurred and occasionally chaoborid larvae were associated. Water mites were abundant. The number of larvae from single pools was never very large.

c. Frost ditches (Fig. 7).—Most numerous on the second terrace, these ditches were one to two feet deep and two to four feet across at the top. The edges were usually noticeably ridged above the surrounding ground level. Their courses were angular and frequently the geometrical patterns were plainly recognizable. Although they were most noticeable in the sloughs, ditches also were present on the surrounding tundra. The sides and sometimes the bottoms of the ditches were moss-covered. Occasionally, low bushes (alders, etc.) growing along the margins provided vegetable litter which covered the bottoms of the pools. The contained water was without current, was clear, and ranged from one to six inches in depth. In addition to a few small emergent bushes there were usually some marginal emergent grass stems. Copepods, diving beetles, and water mites were usually present. Snails were not abundant.

d. Willow-alder pools.—This type of larval habitat frequently occurred in the willow and alder thickets just above the floor level of the river and creek courses (Fig. 8). The pools were generally two to six feet in diameter and one to eight inches deep. Their surfaces were rather clear of emergent material and the bottom was littered with fallen leaves and other vegetable matter. In comparison with the grass sloughs, animal life was not abundant, but any or all of the previously mentioned organisms could be present.

Identification.—In order to facilitate identification of the mosquitoes, 38 collections of larvae were brought into the laboratory and reared to either fourth instar larvae or adults. For positive identification, fourth instar larvae were isolated and the larval and pupal skins were then associated with the resulting adults. In the 130 isolation-rearings completed, associated material was obtained for three species: *Aedes (Ochlerotatus) punctor* (Kirby), *A. (O.) communis* (De Geer), and *A. (O.) nearcticus* Dyar. One third-stage larva of a fourth species, probably *A. (O.) nigripes* (Zetterstedt) or *A. (O.) cataphylla* Dyar, was found, but without

either fourth-stage larvae or adults it cannot be positively identified. Numerous specimens of females caught in the field resembled *A. nearcticus* except for their larger size. These are probably *A. nigripes,* but in the absence of associated larvae or males this identification cannot be verified.[2]

Life history.—From the data gathered it is believed that all of the mosquito species of the true tundra country overwinter in the egg stage. Frozen clumps of tundra marginal to suitable breeding pools were brought into the laboratory soon after the spring thaw and immersed in water. Larvae were found in these pans within 15 hours. Several species of mosquitoes common to southern Alaska, but not found at Umiat, are known to hibernate in the adult stage in the hollows and crevices found in forested areas. Consequently, the absence of forests in the tundra country may partially account for the absence of species hibernating as adults.

The eggs hatch almost immediately after the spring thaw. If a freeze occurs after this, the larvae will freeze into the ice and later thaw out with little adverse effect upon them. Thus, on the first day of the survey (28 May) larvae *(Aedes punctor)* were found in water having temperatures of 35° to 37° F. Some of these larvae were collected and set out in glass jars. On 29 May freezing temperatures occurred which persisted until 2 June (Fig. 9). During this period, water containing the larvae was frozen solidly. After thawing, most of the larvae completed their development. Although small differences in developmental periods were found between the different species, the

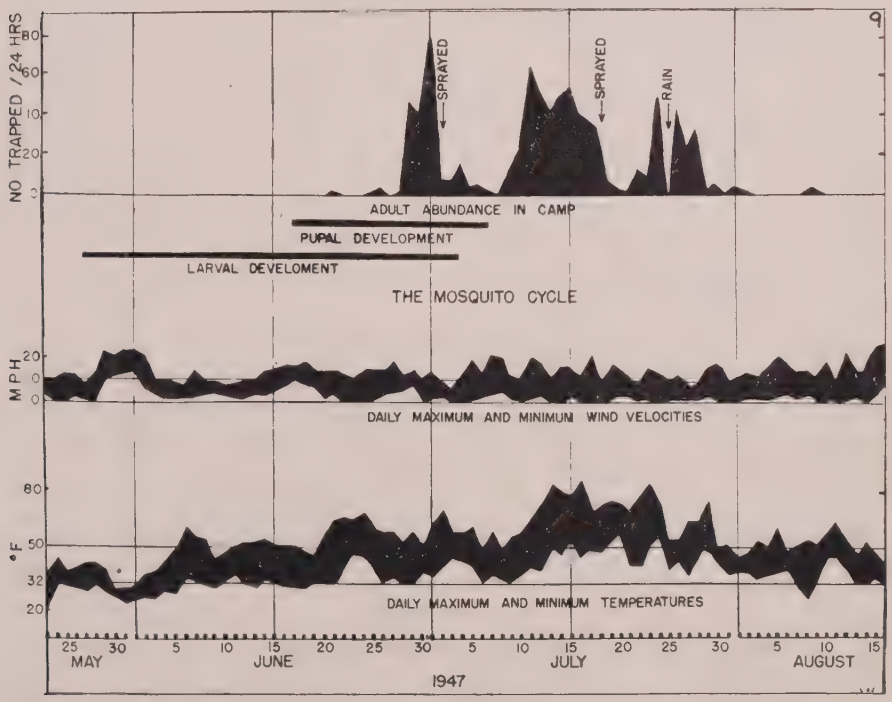

Fig. 9. Relation of the abundance and development of mosquitoes to weather conditions at Umiat in 1947.

period of larval development was approximately 28 days. The pupal period required from three to five days. It was interesting to find that the developmental period of one species *(A. punctor)* depended upon the terrace on which it was found. The higher the level and the more remote it was from the river, the later the date at which the adults emerged. This was true even though the difference in elevation of each terrace was only about 20 feet. This wide range in development is perhaps due to differences in the water and ground temperatures over the various levels of the valley and at varying distances from the ridge to the north for bottom ice was found in the small tundra pools on the third terrace and the portion of the second terrace that lies closest to the hills long after it had disappeared on the first level. Moreover, no larvae of *A. punctor* were found on the first terrace after 18 June, whereas they were found on the second and third terraces as late as 1 July. The first pupae *(A. nearcticus)* were not collected in the field until 17 June, and the last ones *(A. communis)* were found on 5 July. However, larvae brought into the laboratory pupated as early as 12 June.

Although the first adult mosquito was collected in the field on 22 June, emergence continued until 7 July. Peak activity of flying mosquitoes occurred on 1 July when the temperature was high and the wind relatively light (Fig. 9). The males emerged first and remained in the vicinity of the breeding area until the females appeared. Mating was not observed, but must occur almost at once, with the males dying quickly afterwards. Even in the period of their emergence they are seldom encountered naturally. This is particularly unfortunate for at present the adults of these far northern species can be accurately identified only in the male.

Female mosquitoes were encountered everywhere in the area studied, but were most noticeable in the willow and alder thickets. Wind velocity and temperature noticeably influenced their activity (Fig. 9). They were most troublesome on clear warm days when the wind velocity was below five miles per hour. Flying mosquitoes on the open tundra began to disappear when the wind velocity reached seven miles per hour, were scarce at ten miles per hour, and were absent when the velocity was over ten. The adults were strongly responsive to temperature changes. During the chilly night hours they gathered in large numbers about the open doors of heated quarters or hovered in the warm draft from chimneys. When the temperature was less than 47° to 50° F. the activity of the mosquitoes on the open tundra was markedly reduced and at 45° F. they disappeared. A similar reduction in the mosquito density was observed during the afternoons of 13 and 16 July when the temperature approached 80° F. The mosquito population disappeared on 8 August when the daily minimum temperature dipped below freezing for 5 hours. They failed to reappear.

The source of blood meals for the female mosquitoes in this area has not been determined, but if such meals are necessary to produce eggs there is an abundant fauna available to provide them. In addition to occasional bears and moose, there are herds of caribou, large populations of rodents, and numerous nesting birds (ducks, geese, ptarmigan, and song birds).

MOSQUITO CONTROL PROGRAM

This program was not intended to be experimental. Therefore, control was attempted with the materials and equipment that were immediately available.

Equipment.—Most of the spraying was done aerially with a Fairchild "Pilgrim" plane rigged with three 55-gallon drums fitted into the passenger space. The drums were connected by means of rubber and aluminum tubing to a discharge pipe located under the tail. The spray was released through four venturis spaced along the discharge pipe. Loading the plane was facilitated by the use of a centrifugal pump mounted on a "Weasel" (M29C cargo carrier) and powered, by means of a belt connection, by

the "Weasel's" motor. The pumping speed was ten gallons per minute. Under calm wind conditions the swath width of the spray pattern was 70 feet when the plane was flown at an estimated air speed of 90 miles per hour and at an altitude of 15 to 20 feet. However, in spraying operations the swath was reduced to 50 feet to assure complete coverage. The spray was discharged at a rate of eight gallons per minute.

Materials.—Ample supplies of both Diesel fuel oil (30 cetane) and DDT were on hand and about 50 gallons of Stoddard's solvent were available. Two hundred and fifty gallons of an auxiliary solvent (Velsicol AR–50) arrived in mid-July, too late for all but the last adult spraying.

Aerial spraying.—On 10 and 11 June, at moments when suitable weather conditions prevailed, the area north of Umiat camp was given a larvicide spray of 450 gallons of pure Diesel oil. Upon checking the results, it was found that the oil had not spread as a film on the surface of the water, but remained clumped as discrete droplets. Supplementing laboratory experiments showed that at low air temperatures (43° to 54° F.) and lower water temperatures (37° to 39° F.) this Diesel oil would not spread on the surface of the water. However, after testing the available materials the addition of 2.5 gallons of Stoddard's solvent to a drum of oil provided satisfactory spreading properties. Twenty pounds of DDT were added to this mixture in order to increase its insecticidal activity. This preparation sprayed on 12, 13 and 14 June treated an area of approximately 3.7 square miles (Table 2). On 2 July approximately two and one-half square miles were sprayed with 600 gallons of 5 per cent DDT in oil solution to kill adult mosquitoes. The area was resprayed on 18 July with 600 gallons of 10 per cent DDT in oil plus auxiliary solvent.

Hand spraying.—Following the aerial larviciding spray several breeding places found to be inadequately treated were sprayed by hand using two-quart continuous sprayers. The marshes and pools in the valley of Bearpaw Creek, inaccessible from the air, were similarly treated.

Results.—The pure oil spray dispersed from the plane deposited sufficient oil to kill most of the larvae, but due to the failure of the droplets to spread on the surface of the water no larvae were killed. The second spray, the DDT, fuel oil, Stoddard's solvent preparation, produced erratic results. In the marshes exposed to the full sweep of the wind the larvae were all dead at the leeward end, but many were alive at the windward end. In the remaining places, the control was complete, or larvae could be found only after prolonged search. However, because of the number of fairly large breeding areas that required supplementary hand spraying the aerial larvicidal program was unsatisfactory with the dosage and materials used. Following the supplementary hand spraying all mosquito breeding seemed to have been eliminated over an area of approximately two and one-half square miles. Nevertheless, when the mass emergence occurred between 27 and 29 June, both camps were overridden by mosquitoes which presumably infiltrated from surrounding areas.

To check the effectiveness of adult spraying operations daily collections of mosquitoes were made in the vestibule of the laboratory quonset and in the control tower of the radio building, both of which served admirably as mosquito traps. Although not all of the mosquitoes that entered the buildings were captured, the collections did provide an index to the population in the controlled area. Collections were made at irregular intervals at three other sites in the treated area and at two locations outside of the controlled area by aspirating the mosquitoes alighting on one's clothing in a five-minute period. The results were not entirely satisfactory because, regardless of the mosquito density, the maximum number that could be caught in that manner was about 40 in five minutes.

The first adult spraying, using 5 per cent DDT in Diesel oil, was made on

TABLE 2. Summary of aerial spraying program at Umiat, Alaska, in 1947.

Time of spraying		Weather data during spraying				Spraying data					
		Av. temp. °F.		Wind						Dosage/Acre	
Date	Hours	Air	Water	Av. vel.	Prev. dir.	Approx area treated (sq. mi.)	Purpose	Type spray	Amount (gal.)	DDT (lb.)	Oil (gal.)
10 June	1855–2005	43	38	4	N	0.6	Larvicide	Diesel oil	150	—	0.5
11 June	0915–1122	44	39	2	N	1.3	Larvicide	Diesel oil	300	—	0.5
12 June	1437–1833	50	41	8	NE	1.8	Larvicide	DDT*	450	0.2	0.5
13 June	1512–1618	51	42	6	NE	0.6	Larvicide	DDT*	150	0.2	0.5
14 June	1040–1305	51	42	4	NE	1.3	Larvicide	DDT*	300	0.2	0.5
2 July	1000–1600	63	—	4	E	2.5	Adult	DDT†	600	0.2	0.5
18 July	1530–1930	50	—	7	NW	2.5	Adult	DDT‡	600	0.4	0.5

* 5% DDT + 5% Stoddard's solvent in Diesel oil.
† 5% DDT in Diesel oil.
‡ 10% DDT + 10% Velsicol AR 50 in Diesel oil.

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the morning of 2 July. Daily collections at the laboratory quonset beginning on that date indicated that the spraying reduced the mosquito density appreciably for four days (Fig. 9). After weather conditions had checked their activity for an additional three days the population built up to the prespraying density. The second spraying, completed on the evening of 18 July, reduced the population for five days. Mosquitoes disappeared again on 26 July, but this reduction was obviously due to weather conditions since it was a cold and rainy day and the mosquitoes reappeared in numbers the following day. After 1 August few mosquitoes were caught inside or outside of the controlled area. On 8 August cold weather ended the 1947 mosquito season.

SUMMARY

1. Studies on the biology and control of Arctic mosquitoes were made at Umiat, Alaska, in 1947. Larvae were found in grassy sloughs, mossy pools, frost ditches, and willow-alder pools, but not in waters subjected to wind or wave action. A species selectivity for these habitats was observed. Associated rearings were made of three species: *Aedes punctor* (Kirby), *A. communis* (De Geer), and *A. nearcticus* Dyar. One third instar larva of an unidentified fourth species was found.

2. There is only one generation of mosquitoes annually and the Arctic *Aedes* apparently overwinter in the egg stage. Larvae emerge as soon as the ice thaws from around the eggs. Larval development requires almost a month, pupal development about five days, and the adult female mosquitoes persist until the first heavy frost. The adults do not fly when winds exceed ten miles per hour, or when the temperature is less than 45° F. or greater than 80° F.

3. Aerial spraying of fuel oil alone as a larvicide was unsatisfactory, while spraying with a 5 per cent solution of DDT in fuel oil produced erratic results. Five and 10 per cent solutions of DDT in fuel oil applied aerially in a dosage of 0.2 and 0.4 pounds of DDT per acre markedly reduced the adult mosquito population for approximately five days.

ACKNOWLEDGMENTS

We wish to thank Commodore W. G. Greenman, Director of Naval Petroleum Reserves, and Comdr. P. W. Roberts, Officer in Charge of Construction Petroleum Reserve No. 4, for their interest and support of this program; and to Mr. Leo Hopp, U. S. Weather Bureau, for providing the Umiat weather records. Lt. Comdr. K. L. Knight collaborated in collecting essential biological data.

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OUT OF PRINT NUMBERS OF *MOSQUITO NEWS*

Libraries wishing to complete their sets of MOSQUITO NEWS are anxious to secure out of print numbers. One of these, for example, is the General Library of the British Museum of Natural History.

The need for such out of print numbers will grow, since more and more libraries are adding MOSQUITO NEWS to their regular list of periodicals.

Members having early numbers they do not care to keep can help by notifying Mr. T. D. Mulhern, Secretary, The American Mosquito Control Association, New Brunswick, New Jersey, who will be glad to get them.

Numbers especially needed are: Volume 1, No. 1; Volume 1, No. 2; and Volume 3, No. 1.

NEW JERSEY AND NEW YORK MOSQUITO CONTROL EXECUTIVES WITNESS DEMONSTRATION OF "JEEP-A-TRENCH" EXCAVATOR

THOMAS D. MULHERN
Secy.-Treas., American Mosquito Control Association

Through the efforts of Mr. Oliver Stivers, Salt Marsh Field Supt., Essex County Mosquito Extermination Commission, and Mr. William Thom, Asst. Supt. Middlesex County Mosquito Extermination Commission, serving as a special committee of the Associated Executives of Mosquito Control Work in New Jersey, arrangements were made for a demonstration on September 23, 1948, at the Newark, New Jersey Meadows, of the new excavating machine "Jeep-A-Trench" manufactured by the Auburn Machine Works, Inc., 2023 Harney Street, Omaha, Nebraska. The demonstration was conducted by representatives of the Newark, New Jersey Willys distributor, and was attended by representatives of the Bergen, Hudson, Morris, Essex, Union, Middlesex, Somerset, and Mercer County (N. J.) Mosquito Control Commissions, and by representatives of the Nassau County, New York Mosquito Control Board, the New York office of the U.S.P.H.S. Communicable Disease Center, and the New Jersey Agriculture Experiment Station.

The demonstration was held in an area of salt marsh, diked and dewatered by electric pumps of the Essex County Mosquito Extermination Commission. The marsh was very dry, and more than ordinarily firm. The machine operated very well, cutting a 10" wide x 4' deep ditch at a rate of about 5 feet per minute. The ditch has vertical sides, and the spoil is deposited on both banks.

This new excavator was developed primarily for the use of utility companies and others in installing pipe lines, conduits, cables, etc. It is therefore to be expected that there are many situations in mosquito control where it would be unsuitable. However, under suitable operating conditions, it appears to be an efficient tool, for one-man operation.

The unit is attached to the draw bar and frame of the 4-wheel drive civilian type Jeep, and driven from the power take-off. The cutters which do the ditch cutting are attached to a roller chain, the successive cutters being on alternate sides of the chain. Screw conveyors carry the spoil material away from the ditch. A hand wheel at the side raises or lowers the digging column, to a maximum depth

FIG. 1 (Above). "Jeep-A-Trench" ditching unit mounted on civilian Jeep. Digging unit in travel position.

FIG. 2 (Below). Close-up view of digging unit showing digging chain, cutters, and conveyor screws which carry spoil away from ditch.

of 5 feet. Interchangeable digging cutters are available for ditches 6", 8", 10" or 14" wide.

Forward motion is provided by a ratchet device, which transmits power to all 4 wheels, through special gearing. The regular transmission is in neutral gear while the excavator is operating.

Total weight of the Jeep with the excavator attached is 4,400 lbs., and the price quoted was $3,850 complete.

Some of the apparent limitations of this type equipment in mosquito work are:

(1) It can dig only vertical wall ditches.
(2) It can be used only in areas where the terrain is firm enough to support a heavily-laden Jeep.
    It is suggested that for many areas, a crawler tractor would be a more suitable vehicle upon which to mount such a unit.
(3) Because of the type excavating cutters used, it is thought that this machine would not be suitable for cleaning old ditches where the material to be moved is very soft, wet, and "soupy."

Apparent advantages of this new unit are that it is relatively light, easily portable, and it adds still more to the utility of the Jeep which has already proved so useful in the mosquito control field.

Fig. 3 (Below). Digging unit in operation.

Fig. 4 (Above). Ditch with vertical sides 10 inches wide by 4 feet deep, dug at the rate of 5 feet per minute in firm, dry sod on Essex County marsh.

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MOSQUITO GYNANDROMORPHS

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2800 South 20th Street, Philadelphia 45, Pa.

The purpose of this paper is to describe four mosquito gynandromorphs and to bring together other similar aberrant forms of Culicidae which have been recorded in the literature.

Two of the aberrations to be described were obtained while the writer was stationed at the Fourth Service Command Medical Laboratory, Fort McPherson, Atlanta, Georgia, in 1943. Both of these specimens were of *Culex salinarius* Coquillet and were submitted for identification from Camp Gordon, Georgia; both were collected in the same resting station (number 4). The writer is indebted to Dr. Alan Stone of the United States National Museum for the two gynandromorphs of *Orthopodomyia,* for normal specimens of *O. fascipes* (Coq.) for purposes of comparison, and for permission to prepare a slide of the gynandromorph of *Culex nigripalpus* Theob. previously described by Rings.

Warren and Hill (1947) indicated that of approximately 2 million adult mosquitoes identified at Fort McPherson from 1942 to 1946, only five gynandromorphs were noted. Descriptions of four of these have been published (Middlekauff, 1944; Rings, 1946; Warren and Hill, 1947) while one of the new gynandromorphs of *Culex salinarius* to be described here represents the specimen mentioned by Middlekauff as having been lost. Thus of the large number of mosquitoes identified at the Fourth Service Command Medical Laboratory only six gynandromorphs were observed. Although it is quite possible that some aberrant specimens were overlooked, the above ratio indicates the infrequent occurrence of sex mosaics in this family of insects.

The descriptions of the four aberrant specimens follow (only structures present on the specimens and recognizable as to sex are described). Both gynandromorphs of *Culex salinarius* were identified by color previous to being cleared in KOH and mounted in chloral gum medium.

Specimen 1. Gynandromorph of *Culex salinarius* Coq.: Camp Gordon, Georgia, May 27, 1943 (Fig. 4).—Antennae male; left palpus male (terminal segment missing); proboscis male; wings female; left fore tarsus with two small equal claws—one claw simple, the other with a tooth near the base (Fig. 7; predominantly female, though the presence of the tooth indicates a tendency towards maleness); right fore tarsus female; abdomen female; genitalia female, normal, all three spermathecae present (Fig. 5).

Specimen 2. Gynandromorph of *Culex salinarius* Coq.; Camp Gordon, Georgia, June 23, 1943 (Fig. 2).—Antennae male; palpi male, normal (terminal segment of right palpus missing); proboscis male; wings female; right fore tarsus female; abdomen female; genitalia female; normal, all three spermathecae present (Fig. 6).

Specimen 3. Gynandromorph of *Orthopodomyia signifera* (Coq.); Marianao, Cuba, 1936, Coll. H. P. Carr (Fig. 3).—Antennae male; palpi male; wings female; left fore tarsus male; right mid tarsus female; abdomen female; genitalia female, normal, three spermathecae present (Fig. 8).

Specimen 4. Gynandromorph of *Orthopodomyia fascipes* (Coq.); Tabernilla, Panama, August 14, 1908, Coll. A. H. Jennings (reared from larva collected in bamboo trap). (Fig. 1.)—Right antenna male-like in that the terminal two segments are elongated and each of the flagellar segments possesses long fibrillae. However, female structures are represented by the presence of sensilla on flagellar segments I to XI; left antenna female; palpi female-like but with an additional small segment at their apices (Fig. 9); right wing male-like, slightly shorter

FIG. 1. Gynandromorph of *Orthopodomyia fascipes* (Coq.) × 4.3.
FIG. 2. Gynandromorph of *Culex salinarius* (Coq.) × 7.
FIG. 3. Gynandromorph of *Orthopodomyia signifera* (Coq.) × 7.
FIG. 4. Gynandromorph of *Culex salinarius* (Coq.) × 7.

(Photographs by Mr. Alan Wrigley, Microscopy and Photometry Section, Quartermaster Research and Development Laboratories)

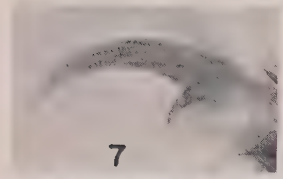

FIG. 5. Genitalia of gynandromorph in FIG. 4. × 94.
FIG. 6. Genitalia of gynandromorph in FIG. 2. × 94.
FIG. 7. Tarsal claw of left fore leg of gynandromorph in FIG. 4. × 426.
FIG. 8. Genitalia of gynandromorph in FIG. 3. × 94.
FIG. 9. Head of gynandromorph in FIG. 1. × 19.6.

(Photographs by Mr. Alan Wrigley)

and narrower than the left; left wing female; left fore tarsus male; right and left mid tarsi female; abdomen female; genitalia female, normal, three spermathecae present.

The other four mosaics described from material submitted to the Fourth Service Command Laboratory follow:

Gynandromorph of *Culex quinquefasciatus* Say, Camp Gordon, Augusta, Richmond County, Georgia, August 15, 1943: "Antennae and palpi as in male, normal. All tarsi are broken off. Genitalia as in female, spermathecae not visible." (Middlekauff, 1944).

Gynandromorph of *Culex pipiens-quinquefasciatus,* Camp Tyson, Paris, Henry County, Tennessee, September 1, 1943 (both *C. pipiens* and *C. quinquefasciatus* occur in this region and since the adult females are difficult to separate by color, both specific names are given).—"Right antenna, right palpus (apical segment broken off), right fore and left mid tarsi as in male, normal. Left antenna as in female but with some unusually long hairs; left palpus short as in female but distorted apically; left fore tarsus broken; right mid tarsus as in female, normal. Genitalia female, normal, with spermathecae." (Middlekauff, 1944.)

Gynandromorph of *Culex nigripalpus* Theobald, Hunter Field, Savannah, Georgia, September 28, 1945.—Taken in light trap. ". . . typical male antennae and palpi; the legs and wings were proportionately more slender, as in normal males, than analogous female structures. The genitalia, size and shape of the abdomen and abdominal scale pattern were characteristically female." (Rings, 1946.) Rings' description was based on an examination of an adult mounted on a triangular point. This specimen was cleared in KOH and mounted in chloral gum medium. Additional information concerning this aberrant is as follows: right fore tarsus male; left and right mid tarsi female; wings appear female; genitalia female, normal, three spermathecae present.

Gynandromorph of *Culex nigripalpus* Theobald, Fort Jackson, South Carolina, September 23, 1946.—Taken in light trap. "This specimen possesses antennae and palpi which are typical female and the abdomen and genitalia exhibit typical male characteristics." (Warren and Hill, 1947.)

The above eight gynandromorphs are deposited in the United States National Museum.

Felt (1904, pp. 467–468) described two gynandromorphs of the genus *Aedes* which apparently have been overlooked by earlier writers. These include a mosaic of *Aedes (Ochlerotatus) implacabilis* Walker (= *Culicada abserratus* Felt), and one of *Aedes (Ochlerotatus) pullatus* (Coquillet) (= *Culicada pullatus* Coq.). Carpenter (1948) described a gynandromorph of *Aedes canadensis* (Theob.). The records of other mosquito gynandromorphs are chiefly from Great Britain. Edwards (1917, pp. 216–217) described three gynandromorphs of *Aedes (Ochlerotatus) punctor* Kirby (= *Ochlerotatus nemorosus* Mg.). Shute (1926) described one mosaic also of *Aedes punctor.* Marshall (1938, pp. 312–313) reported three gynandromorphs, one each of *Aedes (Ochlerotatus) detritus* Haliday, *Culex pipiens* Linn. and *Culex molestus* Forskal. All of the above British records are reviewed by Marshall (1938, pp. 310–313). In addition to the foregoing records, Brelje (1923) gave a very complete description (both internal and external morphology) of a gynandromorph of *Aedes punctor* (= *A. meigenanus*); and Classey (1942) recorded a gynandromorph of *Theobaldia annulata* Schrank.

Very little is known about the behavior of mosquito gynandromorphs since they are, as a rule, noticed after the insects have been killed. Howard (1901, p. 37) recorded the observation of Dr. C. W. Stiles who in the summer of 1889, at "Leipsic" was bitten by a specimen of *Culex nemoralis* which succeeded in sucking blood, and which ". . . possessed male antennae." This convinced Stiles that ". . . either the males do occasionally bite or that occasionally females possess feath-

ered antennae." Edwards (1917) collected his "male" specimens while they were feeding on his hand and ankle. "A close examination later of the three specimens taken showed that none of them were normal males, but all three had one or more female characters on one or both sides of the body. It seems not improbable, therefore, that other male specimens of various mosquitoes which have occasionally been recorded as biting were really partly hermaphrodite." Of particular interest is the fact that one of Edwards' specimens lacked mandibles. Patton and Evans (1929) believed that the mandibles were unimportant in the piercing mechanism and Robinson (1939, p. 231) suggested that deficiency experiments should be performed as verification for Patton & Evans' suggestion. Since one of Edwards' gynandromorphs lacked mandibles but succeeded in sucking blood, the mandibles in this case were not necessary for piercing. Shute's (1926) gynandromorph was collected alive but he could not get it to take a blood meal, though the head was predominantly female and the abdomen, male.

Nothing is known of the sexual behavior of mosquito gynandromorphs but from observations on aberrations of this kind in other groups of insects one can speculate as to the behavior of these sex mosaics. It is generally accepted that insect sexual behavior is not under the influence of the gonads (Wigglesworth, 1939, p. 383). Morgan and Bridges (1919, pp. 22–23) described the courtship of Drosophila gynandromorphs; one specimen, male throughout except for female genitalia, was tested by Sturtevant and behaved as a male. Snyder (1946, p. 351) [1] recorded one case where a bilateral gynandromorph of Drosophila when placed with other flies of both sexes responded by vibrating the wing on the male side (i.e., male response) and extending the wing on the female side (i.e., female response). Whiting (1943, p. 238) tested five specimens of *Habrobracon juglandis* (Ashmead) which were masculine anteriorly and feminine posteriorly and found that they were indifferent to caterpillars (i.e., did not attempt to parasitize) but made ". . . vigorous attempts to mate with females, indicating the brain to be structurally male." Bates (1941, p. 170) concluded from his study of anopheline mosquitoes that the sexual behavior pattern is probably ". . . not dependent on the functioning of the primary sexual organs, . . ."

Roth (1948) showed that the sound produced by the female of *Aedes aegypti* (Linn.) is the external stimulus which attracts and induces the male to copulate. Certain sound frequencies, produced by tuning forks or an audio oscillator speaker, will induce the males of *aegypti* to give a typical mating response which is comparable to the copulating behavior with the female. This response of caged *aegypti* males induced by a sound stimulus can be broken down into four distinct behavior patterns as follows: (1) males which are at rest when exposed to a stimulating sound frequency take to *flight;* (2) after taking to flight the males are *attracted* to the sound source (e.g., tuning fork of 480 to 512 vps.); (3) once attracted the males seize and cling to the cloth of the cage (with their front and middle legs) near the sound source and their wings continue to vibrate, a behavior comparable to seizing the female in flight and therefore called the *seizing response;* (4) the fourth behavior pattern consists of flexing the abdomen ventrad so that the genitalia touch the cloth of the cage; this corresponds to the final stage in copulation when the male makes connection with the female and is called the *clasping response.* Males of *Culex pipiens* Linn., *Anopheles quadrimaculatus* Say and *Psorophora confinnis* Lynch-Arrib. when in a "mating-state" also give a mating response to sound but usually it is not as vigorous as that of *aegypti.*

It is likely that sexual mosaics in which the head is male and the abdomen female (Figs. 2–4) would react like a male and attempt to copulate with normal females though copulation would be unsuccessful

[1] A personal communication to Dr. L. H. Snyder from Prof. A. M. Winchester, Oklahoma Baptist University.

because of the lack of male genitalia. Whether or not a male-acting individual would succeed in seizing a partner would also depend upon the character of the last tarsal segments and claws of the front and/or middle legs since the female tarsi are not structurally suited for seizing and holding the male; the male tarsi of the front or middle legs, or both (depending upon the species) are suited for seizing and holding the female (see Roth, 1948). If the wings of the gynandromorph are female the sound produced by them in flight would no doubt fall within the spectrum which would attract, and therefore normal males would attempt to copulate with these gynandromorphs. An aberration in which the head is female and the remainder male probably would play the passive rôle of a female and would not attempt to mate with other females in spite of the presence of male genitalia. Such individuals with male wings and abdomen (but female heads) would produce a sound in flight which would fall outside the range which acts as a mating stimulus (the pitch of sound produced by a male in flight is higher than that produced by a female) for males and hence, theoretically, these individuals should not attract normal males. It is difficult to predict the mating behavior of a complete or partial bilateral gynandromorph (Fig. 1, and Felt's specimen of *A. implacabilis*) or of a form in which the structures are deformed or show characteristics of both sexes. Would an aberrant form in which one side (right or left) was male and the other female show a characteristic male mating response to a female or mechanically produced sound? If bilateral gynandromorphs behave in a manner similar to certain bilateral Drosophila gynandromorphs recorded in the literature, then the male side would behave as a male (i.e., give a seizing response) and the female side as a female. Since the female mosquito appears to be passive, except for flight, during mating, she would show no behavior indicative of a mating response. The male side of a bilateral mosquito gynandromorph could conceivably give a seizing response to stimulating sound frequencies, but whether or not the male would take to flight, be attracted and give a clasping response to these sounds (or to a female) remains to be shown from observations on living aberrants.

Summary

Four new mosquito gynandromorphs are described. These include two specimens of *Culex salinarius* Coq., one specimen of *Orthopodomyia signifera* (Coq.) and one specimen of *Orthopodomyia fascipes* (Coq.). Other mosquito gynandromorphs from the literature are reviewed. Sex mosaics have been noted in the following species: *Aedes implacabilis* (Walker), *Aedes pullatus* Coq., *Aedes canadensis* (Theob.), *Aedes punctor* Kirby, *Aedes detritus* Haliday, *Culex pipiens* Say, *Culex quinquefasciatus-pipiens, Culex nigripalpus* Theob., *Culex molestus* Forskal, and *Theobaldia annulata* Schrank. The probable behavior of mosquito gynandromorphs is discussed.

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THE CALIFORNIA MEETINGS TO HAVE STATE, NATIONAL, AND INTERNATIONAL SIGNIFICANCE

The joint annual meeting of the American Mosquito Control Association and the California Mosquito Control Association will be held at Berkeley and Oakland, California, on February 6–9, 1949. The program will be truly international in scope with outstanding speakers from other countries, as well as from all parts of the United States. One day will be devoted to international, one day to national, and one day to local California topics.

The several phases of mosquito control, and the advances in knowledge made recently will be presented, including those in the fields of mosquito control engineering, entomology and chemistry.

Invitation to attend is extended to all interested. You may have your name placed on the list to receive a copy of the program when it is printed by writing to Mr. Harold F. Gray, Program Chairman, AMCA, 1-A Court House, Oakland, California.

The meeting will be followed by an inspection tour, February 10–15, of some of the work being accomplished in ridding California of the Mosquito Pest.

PROGRAM

for the

JOINT ANNUAL MEETING

of the

AMERICAN MOSQUITO CONTROL ASSOCIATION

and the

CALIFORNIA MOSQUITO CONTROL ASSOCIATION

at

BERKELEY AND OAKLAND, CALIFORNIA

February 6–9, 1949

HEADQUARTERS, CLAREMONT HOTEL, OAKLAND

Claremont Hotel, Berkeley, Calif.

Photo by Martin Hutchinson,
Rutgers Univ., New Brunswick, N. J.

Program Committee

HAROLD F. GRAY, Chairman, Room 1A, Court House, Oakland, Cal.

ARCHIE D. HESS
T. D. MULHERN
T. D. RALEY
H. H. STAGE
H. D. PETERS

PROGRAM

JOINT ANNUAL MEETING

AMERICAN MOSQUITO CONTROL ASSOCIATION

and

CALIFORNIA MOSQUITO CONTROL ASSOCIATION

PLACE OF MEETING—Berkeley and Oakland, California
followed by a field trip (motorcade)

HEADQUARTERS—Claremont Hotel, Oakland

Sunday, February 6, 1949, Afternoon, Claremont Hotel

Noon Registration

2:00 p.m. Committee Meetings—American Mosquito Control Association

2:00 p.m. Committee Meetings—California Mosquito Control Association

5:00 p.m. Hospitality Hour

Monday, February 7, 1949, at Agriculture Hall, University of California, Berkeley

International Day

9:00– 9:10 a.m. Opening Address and presentation of retiring President of the American Mosquito Control Association, by T. G. Raley, President, California Mosquito Control Association.

9:10– 9:20 a.m. Response, H. D. Peters, Health Department, Jacksonville, Fla.

9:20– 9:30 a.m. Welcome by the Vice-President of the University of California, Claude B. Hutchinson, Dean, College of Agriculture.

9:30– 9:35 a.m. Welcome by E. O. Essig, Head, Division of Entomology and Parasitology, College of Agriculture, University of California.

9:35– 9:40 a.m. Welcome by Edward S. Rogers, M.D., Dean, School of Public Health, University of California.

9:40–10:15 a.m. C. R. Twinn, Chief, Household & Medical Entomology Unit, Division of Entomology, Department of Agriculture, Ottawa, Toronto, Canada. *Mosquito Control Problems in Canada.*

10:20–10:50 a.m. B. V. Travis, Bureau of Entomology & Plant Quarantine, U.S.D.A. Orlando, Florida. *Mosquito Control Problems in Alaska.*

11:00–11:30 a.m. Leonard J. Chwatt, Yellow Fever Research Institute Lagos, Nigeria, Africa. Anopheles Gambiae (var. Melas) *Control by Swamp Drainage in a Coastal Area of Africa.*

1:00– 1:10 p.m. Fred L. Soper, M.D., Director, Pan American Sanitary Bureau, Presiding. Introductory Remarks.

1:10– 1:30 p.m. S. D. Macready, General Sanitary Inspector, United Fruit Company, San José, Costa Rica. *Observations After Three Years' Use of DDT Residual Spraying of Tropical Labor Camps for* Anopheles Albimanus *Control.*

1:40– 2:10 p.m. Pedro Galindo V., Chief, Anti-Malaria Division, Department of Health, Republic of Panama. *Recent Advances in the Control of Malaria in Panama* (with film).

2:15– 2:25 p.m. Leonidas M. Deane, M.D., Instituto Evandro Chagas, Belem, Para, Brazil. *Malaria in the Amazon Region of Brazil: A Summary of the Present Knowledge of Its Distribution, Transmission and Control.*

2:25– 2:55 p.m. Luis Vargas, M.D., Institute of Health and Tropical Diseases, Mexico, D. F., Mexico. *Mosquito Control Problems in Mexico.*

3:05– 3:25 p.m. Charles M. Wheeler, Public Health & Welfare Section, Supreme Commander of the Allied Powers, Tokyo, Japan. *Vector Control Problems in Japan.*

3:40– 4:00 p.m. Thomas H. D. Aitken, International Health Division, The Rockefeller Foundation, Cagliari, Sardinia, Italy. *Mosquito Control Problems in Sardinia.*

4:10– 4:35 p.m. William McDowell Hammon, M.D., Hooper Foundation for Medical Research, University of California, San Francisco, and Lecturer in Public Health, School of Public Health, University of California, Berkeley. *Public Health Problems Relating to Virus Encephalitis*

Diseases in the Far East and the Pacific Islands.

4:45– 5:10 p.m. George H. Bradley, Communicable Disease Center, Public Health Service, Atlanta, Georgia. *The Present Status and Future Plans of the Public Health Service, Malaria Control Program.*

7:30 p.m. Business Meeting, American Mosquito Control Association, Claremont Hotel.

8:30 p.m. Business Meeting, California Mosquito Control Association, Claremont Hotel.

Tuesday, February 8, 1949, in the Florentine Room, Claremont Hotel, Oakland

American Mosquito Control Association Day

9:00– 9:05 a.m. Introduction of new President of the American Mosquito Control Association, by retiring President H. D. Peters.

9:05– 9:20 a.m. President's Address.

9:25– 9:40 a.m. Report from New Jersey Mosquito Extermination Association.

Bailey B. Pepper, New Jersey Agricultural Experiment Station, New Brunswick, New Jersey, or Thomas D. Mulhern, New Jersey Agricultural Experiment Station.

9:45–10:00 a.m. Report from Florida Anti-Mosquito Association—M. V. Provost, Biologist, Division of Entomology, Florida State Health Department.

10:05–10:20 a.m. Report from Virginia Mosquito Control Association—Perry W. Ruth, Bureau of Vector Control, Department of Public Welfare, Norfolk, Virginia.

10:25–10:35 a.m. Report from Utah Mosquito Control Association—Don M. Rees, Professor of Entomology, University of Utah, Salt Lake City.

10:55–11:05 a.m. Report from Illinois—J. Lyell Clarke, Engineer, Desplaines Valley Mosquito Abatement District, Lyons, Illinois

11:05–11:15 a.m. Report from New York—R. D. Glasgow or D. L. Collins, New York Science Service, Albany.

11:20–11:30 a.m. Report from New England. (Speaker to be selected.)

11:30–11:45 a.m. Report from Oregon—Dorothy McCullough Lee, Mayor, Portland, Oregon.

11:45–11:55 a.m. Report from the State of Washington. M. Mondala, Supervising Sanitarian, State Health Department, Seattle.

1:15– 2:45 p.m. *Symposium on Ground Pre-Treatment for* Aedes *Control.* B. V. Travis, Bureau of Entomology and Plant Quarantine, Orlando, Florida, presiding: C. R. Twinn, A. W. Lindquist, Basil Markos.

2:45– 2:55 p.m. Ralph Bunn, Major, MSC, Medical Department, U. S. Army—*The Place of Entomologists in the Medical Service Corps, Medical Department, U. S. Army.*

3:05– 4:55 p.m. *Symposium on the Uses and Limitations of New Insecticides*—F. C. Bishopp, Assistant Chief, Bureau of Entomology and Plant Quarantine, Washington, D. C., presiding: B. V. Travis, BEPQ, *The Uses and Limitations of Insecticides for Mosquito Control by the Military;* T. D. Mulhern, N. J. Agric. Expt. Sta., *Insecticides Used in Salt Marsh Mosquito Control;* Archie Hess, TVA, *The Uses and Limitations of Insecticides in Mosquito Control in the TVA;* G. H. Bradley, USPHS, *Malaria Control Through the Use of New Insecticides as Residual Sprays;* Oliver B. Cope, Fish & Wildlife Ser., *The Effect of Mosquito Insecticides on Wildlife;* Allen B. Lemmon, Calif. State Dept. of Agriculture, *The Toxicity of Insecticides to Man and Domestic Animals.*

8:00 p.m. Dinner Dance. Florentine Room, Claremont Hotel. Obtain tickets ($.... each) at time of registration.

(Speaker to be announced.)

Wednesday, February 9, 1949, Claremont Hotel, Oakland (Florentine Room)

California Mosquito Control Association Day

9:00– 9:05 a.m. Presentation of new California Mosquito Control Association President, by retiring President T. G. Raley.

9:05– 9:10 a.m. President's Remarks.

9:10– 9:30 a.m. Address—W. L. Halverson, M.D., State Director of Public Health, San Francisco, California.

9:35–10:00 a.m. Dorothy Nyswander, Professor of Public Health Education, School of Public Health, University of California, Berkeley. *The Uses of Modern Tech-*

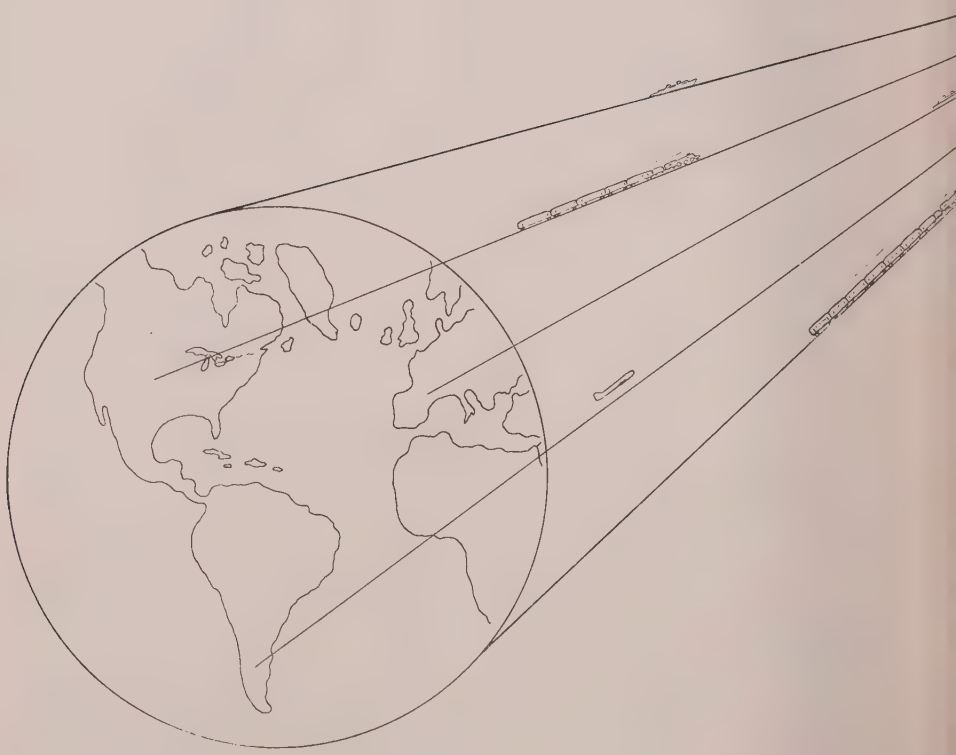
IT'S BERKELEY IN '49

WITH THE

AMERICAN MOSQUITO CONTROL ASSOCIATION

CALIFORNIA MOSQUITO CONTROL ASSOCIATION

FEBRUARY 6 - 15



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niques of Public Health Education as Applied to the Work of Mosquito Abatement Agencies.

10:10–10:30 a.m. Stanley B. Freeborn, Assistant Dean, College of Agriculture, University of California, Berkeley. *The Relationship of Mosquito Abatement Agencies to Other Agencies of Government.*

10:50–11:15 a.m. Arve H. Dahl, Chief, Bureau of Vector Control, State Department of Public Health. *Progress of Mosquito Control Operations in 1948 in California.*

11:25–11:50 a.m. H. H. Stage, Bureau of Entomology and Plant Quarantine, USDA, Washington, D. C. *Research on Mosquito Control in the Bureau of Entomology and Plant Quarantine in 1948.* (Illustrated with Kodachrome slides.)

1:15– 2:15 p.m. *Symposium on New Equipment and Recent Improvements in Methods of Drainage and Application of Insecticides by Ground Equipment.* Thomas D. Mulhern, New Jersey Agricultural Experiment Station, New Brunswick, New Jersey, presiding: Vernon Conant, R. E. Dorer, John M. Henderson, T. G. Raley.

2:40– 3:50 p.m. *Symposium on Recent Improvements and Experience in the Use of Aircraft in Mosquito Control.* H. H. Stage, Bureau of Entomology and Plant Quarantine, USDA, Washington, D. C., presiding: A. D. Hess, A. F. Geib, T. M. Sperbeck.

4:05– 4:30 p.m. W. B. Herms, Emeritus Professor of Parasitology, University of California, Berkeley. *A Backward and a Forward Look at Mosquito Control.*

7:30 p.m. Business Meetings. Claremont Hotel.

Thursday, February 10, 1949

Motorcade Tour

Important Notice: Applications for *Reservations* for this Motorcade Trip must be in the hands of the Chairman of the Motorcade Committee, E. Chester Robinson, P. O. Box 1023, Modesto, California, not later than *January 14, 1949*, in order that all necessary arrangements for cars, hotel reservations, meals, etc., can be made. A *Reservation Fee of $10.00 per Person* must accompany the application for reservations on the Motorcade, except in the case of visitors from foreign countries. This reservation fee will apply on hotel and entertainment charges in Los Angeles.

Motorcade cars, guides and a baggage truck will be furnished gratis to *out-of-California visitors* by the California Districts. Detailed road maps and driving directions will be supplied.

8:30 a.m. Motorcade leaves Claremont Hotel, and traverses Alameda County via Niles, thence north via Carquinez Bridge and Woodland to Marysville, California. Visit Sutter-Yuba Mosquito Abatement District. Overnight in Marysville.

Friday, February 11, 1949

8:30 a.m. Leave Marysville, via River Road to Sacramento; State Capitol Park; to Modesto, visiting East Side Mosquito Abatement District and Turlock (Turlock Mosquito Abatement District); to Merced, visiting Merced Mosquito Abatement District. Overnight at Merced.

Saturday, February 12, 1949

8:00 a.m. Leave Merced and drive to Yosemite Valley via All Year Highway. Program on Control of mountain *Aedes* mosquitoes in National Parks. Return trip via Mariposa to Fresno. In evening visit a winery. Overnight in Fresno.

Sunday, February 13, 1949

8:30 a.m. Leave Fresno. If weather in mountains permits, drive via the Generals' Highway through Kings Canyon and Sequoia National Parks (Grant and Giant Forest groves of redwoods) to Visalia. If weather in mountains prevents, drive direct to Visalia, thence via Porterville through the orange and lemon orchard belt to Bakersfield. Overnight in Bakersfield.

Monday, February 14, 1949

9:00 a.m. Visit Kern Mosquito Abatement District. Drive via Arvin to Los Angeles. (Mayfair Hotel.) In evening visit a national broadcast studio performance. Overnight in Los Angeles.

Tuesday, February 15, 1949

9:00 a.m. Motorcade leaves Biltmore Hotel, for trip via Griffith Park, San Fernando Valley, Toluca Lake District, various movie studios, Beverly Hills, Bel-Air, Pacific Palisades, ocean beaches, etc., etc.

5:30 p.m. Banquet, Mayfair Hotel.

8:30 p.m. Evening entertainment at Los Angeles' famous night spot, "The Drunkard."

(*Note:* Cost of features in Los Angeles, including hotel two nights, banquet, entertainment, is estimated to run between $18 and $24 per person: the $10 deposit will apply thereon.)

The evening's entertainment marks the close of the motorcade trip.

Notice: Out-of-state visitors going on the motorcade should arrange their rail or air transportation so as to arrive at either Berkeley or Oakland, California, on Sunday, February 6, 1949, and to depart from Los Angeles on Wednesday, February 16, 1949, or later according to their convenience.

Hotel Reservations: Hotel reservations for the meetings in Oakland and Berkeley should be made well in advance. Requests for reservations should be sent to Richard F. Peters, Chairman, Reservations Committee, California Mosquito Control Association, P. O. Box 649, Berkeley 1, California, accompanied by a $5.00 deposit. Reservation deposits will be waived for visitors from foreign countries. Reservations for foreign and out-of-state speakers and members will be made at the Claremont Hotel, Oakland. California members will be accommodated mainly at the Shattuck and Durant Hotels in Berkeley, and the Leamington and Coit Hotels in Oakland. The Reservation Committee will notify visitors as to the hotel accommodations secured for them.

Clothing: As there will be snow in the Yosemite Valley and Sequoia National Park in February, warm clothing should be brought by those persons going on the motorcade trip. A rain coat is also advisable. February temperatures in Berkeley and Oakland are mild (40°–70° F.). Weather in Los Angeles in February is generally mild.

Ladies' Entertainment

Tuesday, February 8, 1949

9:30 a.m. Claremont Hotel. Cars will be provided to take women visitors on a tour of the San Francisco Bay area, visiting points of special interest. Mrs. G. E. Washburn, Chairman.

8:00 p.m. Dinner dance, Florentine Room, Claremont Hotel.

Wednesday, February 9, 1949

2:00 p.m. Special entertainment for women visitors. Details to be announced later.

Tuesday, February 15, 1949. At Los Angeles.

10:00 a.m. Conducted shopping tour.

COMMITTEES: American Mosquito Control Association

Program: Harold F. Gray, Chairman
1-A, Court House, Oakland 7, California
Archie D. Hess
T. D. Mulhern
H. D. Peters
T. G. Raley
H. H. Stage

COMMITTEES: California Mosquito Control Association

General: G. Edwin Washburn, Chairman
P. O. Box 629, Turlock, Calif.

Motorcade: E. Chester Robinson, Chairman
P. O. Box 1023, Modesto, Calif.

Finance, Publicity, Exhibits:
Theodore G. Raley, Chairman
P. O. Box 278, Selma, Calif.

Registration, Hotel Reservations, University:
Richard F. Peters, Chairman
P. O. Box 649, Berkeley 1, Calif.

Ladies' Entertainment:
Mrs. G. E. Washburn, Chairman
Mrs. E. Chester Robinson
Mrs. A. Preuss
Mrs. H. F. Gray

FACTS ABOUT THE METROPOLITAN OAKLAND AREA

The Metropolitan Oakland Area (the whole of Alameda County) with a present population in excess of 735,000 residents, extends eastward from the mainland shores of San Francisco Bay some 35 miles through rolling hills and valleys to the edge of San Joaquin valley. Along this strip, from the edge of the Bay to the foothills, are located the cities of Albany, Berkeley, Emeryville, Piedmont, Oakland, Alameda, San Leandro, and Hayward. Comprising this strip is an almost unbroken chain of factories and waterfront industries, commercial trading centers and residences.

The Metropolitan Oakland Area is a rapidly growing industrial and agricultural empire in which is concentrated the bulk of the entire Bay region's population and industrial payrolls. The 1940–1947 rate of growth for the Oakland side of the Bay was 67% as against 32% on the west side.

More than 1,300 industrial plants are located in the Metropolitan Oakland area, including over 200 nationally known manufacturers. During 1947 59 new industries, with a total plant investment in excess of $15,000,000 were established in the area, and plant expansion in the same period totaled nearly $25,000,000 in investment. Since V-J Day metropolitan Oakland has topped all Northern California counties in the acquisition of new industries.

The City of Oakland, third largest city in California, with a present population in excess of 425,000, is the hub of the 840-square-mile metropolitan Oakland area, and is the point of convergence of highway routes and airways which blanket the state to the north, east, and south, and additionally is the hub of water and air routes linking the Pacific Ocean area trading centers with the mainland side of the United States. Its harbor is one of the largest and finest in the world. In the rail transportation field, the city is the western terminus of all three transcontinental passenger and freight trains. Oakland's modern municipal airport, known as the Airway Center of the West, ranks 7th in the nation in airport activity.

1. Producing center of internationally famous California wines.
2. Third market on the Pacific Coast.
3. Industrial hub of California.
4. 15th U. S. county in 1947 retail sales.
5. 16th county in nation in size of population.
6. City of homes, 80% one-family dwellings, with over 50% of all homes owner occupied.
7. National distribution center of the West.
8. Largest power pool in the world located in metropolitan Oakland area.
9. A favored industrial area, where air, rail and water transportation meet.
10. Oakland, the only city in the world with a mile long tidal salt water lake located in the heart of the city.
11. Calculating machine center of the world.
12. Leading and fastest growing industrial county in Northern California.
13. Average monthly pay of Alameda County workers 6th in the nation.
14. 11th county in the nation in total automobile registration, second in California.
15. Floriculture center of Northern California—$10,000,000 worth of flowers and seeds shipped annually from Alameda County, mostly by air express, to East Coast.

NEWS AND NOTES

California Mosquito Control Is Big Business. Fiscal Year Summary Indicates Mosquito Control Big Business. A summary of mosquito control activities during the fiscal year 1947–48 by 19 mosquito control agencies participating in the vector control subvention program confirms the fact that mosquito control in California is a significant program.

During the year over a hundred tons of DDT and DDD were used in larviciding and adulticiding operations. Add to this over 21,000 gallons of oil. Approximately 115,000 man hours and 1,600 airplane hours were consumed in these operations.

Approximately 50 miles of ditches and drains were constructed and nearly a hundred cubic yards of earth were filled in low areas. Over 60 miles of access roads were constructed and nearly 200 miles of ditches and drains were maintained. Approximately 11,250 acres of vegetation were removed. These activities consumed approximately 40,500 man hours.

The entire program involved nearly 480,000 man hours of which approximately 62% were charged to rural operations, 13% to urban operations and 25% to unclassified operations. A percentage breakdown of man hours according to activities follows:

Larviciding, 18.4%; adulticiding, 5.3%; drainage construction and maintenance, 8.4%; entomological inspections and surveys, 30.5%; general supervision and engineering surveys, 11.3%; clerical assistance, 6.3%; public relations, 1.3%; all other operations, 18.5%.

Ten thousand six hundred forty-eight square miles of area received the above control or surveillance and nearly 1,700,000 vehicle miles were traveled.

The above figures pertain to less than half of the mosquito control agencies in California, although over half of the total activities for the State are represented.—*Mosquito Buzz*, Sept. 15, 1948.

New Jersey's loss is Washington's gain! It will not be news to some AMCA members that November 1, 1948, was the date of transfer for Ralph J. Van Derwerker, Superintendent-Engineer, Union County Mosquito Extermination Commission, to the U. S. Public Health Service. His assignment as Senior Sanitary Engineer (Lt.-Col.) in the Pan-American Sanitary Bureau, Washington, D. C., should prove most interesting. He will supervise the Bureau's engineering staff and assist them in projects on sanitation operations in the 22 member nations of the Pan-American Union.

H. L. T.

It is always a pleasure to become better acquainted with members from outside the United States, therefore we submit a few facts about our Brazilian friends.

Dr. A. L. Ayrosa Galvão is a professor in the Dept. of Parasitology, School of Hygiene and Public Health, University of São Paulo, at São Paulo. Last May, he and his wife attended the International Congresses on Tropical Medicine and Malaria, in Washington, D. C. Dr. Galvão presented a paper entitled, "Recent or Contemporaneous Active or Passive Dispersion of Anopheline Species."

Dr. Leonidas M. Deane, of the Special Service of Public Health at Belem, Pará, North Brazil, is engaged in taxonomic and biological studies on anophelines and in malaria control with DDT. He has contributed a review for this issue of Mosquito News.

Dr. René Rachou, Chief Entomologist in the National Malaria Service, is making an anopheline survey in the State of Paraná, Southern Brazil.

Dr. Abel Vargas, Chief of Malaria Control, Light and Power Company, State of Rio de Janeiro and São Paulo, is interested especially in malaria control on impounded water.

Dr. Fernando M. de Bustamente, heads a group of physicians in the National Malaria Service, which is making malaria surveys in several states of Brazil. This work is being carried out in areas where DDT house-spraying is planned. The doctors will evaluate the effect of DDT on malaria transmission by making spleen and parasite examinations of school children before the DDT program and every year thereafter.

Doctors Galvão, Deane, Rachou, and Vargas attended the Congresses and submitted their applications to the AMCA last May. Dr. Bustamente, who furnished much of the above information, has been an enthusiastically cooperative member since 1946.

H. L. T.

A note from Ernestine B. Thurman informs us that her husband, D. C. Thurman, is now located at the School of Public Health, University of California, Berkeley. Ernestine, who was formerly employed in CDC in Jacksonville, Florida, concludes, "For the present, I am keeping exceedingly busy with the domestic necessities of making a small apartment comfortable."

H. L. T.

A bold experiment that aims at the complete eradication of the mosquito from the whole of the island of Mauritius, east of Madagascar, in the Indian Ocean, was scheduled to commence in September under the auspices of the Colonial Insecticides Committee of Great Britain. The island has an area of 720 square miles and a population of 425,000. Malaria was first introduced about 1862 and for many years has been

the principal cause of death in the colony. In 1942 over 3,000 persons died from the disease. The malaria vectors appear to be *Anopheles funestus* Giles and *A. gambiae* Giles and the new insecticides DDT and benzene hexachloride will be used in the attempted eradication.

H. H. S.

In connection with the above note by Harry Stage, we bring the following to your attention:

1. The comprehensive survey on malaria in Mauritius by Sippe and Twining, referred to in Stage's Bibliography in this issue. Also, the excellent review in Trop. Dis. Bull. 45(2):134–135. Feb. 1948.
2. The fact that all 3 malarias are present on the island. *Plasmodium falciparum* and *P. vivax* predominate, while *P. malariae* is responsible for approximately one-quarter of the infections.

H. L. T.

FLY CONTROL WORK CARRIED ON BY CALIFORNIA CONSOLIDATED MAD. John Panzak, the Fowler foreman, is carrying on an extensive cleanup campaign to eradicate fly breeding areas. He has the full cooperation of all city officials, and believes with good publicity can nearly rid Fowler of flies. He still needs a good insecticide to kill the adults.—*Mosquito Buzz,* Aug. 15, 1948.

EDITOR'S LAMENT

Last page, last column
Editor's gettin' mity solemn.
Went to P.O. Found it dry.
Again no contributions! Why?

If you want the BUZZ to buzz
Better start 'em flowin' cuz
God ain't editing the BUZZ
Oh how I wish he wuz!

Mosquito Buzz, Aug. 15, 1948.

Perry Ruth, President of the Virginia Mosquito Control Association and technical advisor of the Norfolk Mosquito Control Commission, is determined to keep the public well-informed on the subject of mosquitoes and mosquito control activities.

The Norfolk Virginian-Pilot of August 26 carried a story of an educational meeting held in the Mosquito Control Commission's field office, where representatives of the Federation of Garden Clubs of Norfolk and vicinity were guests of Mr. Ruth. A picture of Perry and the city's anti-mosquito staff, a group of ten young college men, illustrated the news story.

Under the sub-title of "How to stalk a mosquito," the same paper on September 3 took up the subject of hydraulic fills and reasons for their being such a headache to mosquito control men. The article states: "This year the last four troublesome ones in Norfolk, comprising some 360 acres, have been conquered for the first time, Perry W. Ruth announced yesterday."

Two illustrations accompany this article, one of a "drainage ditch to lessen bites" and one of "big bucket in mosquito fight." The latter shows heavy equipment shoveling its way through a 30-year-old fill.

H. L. T.

Dr. Leonard Jan Chwatt, Medical Entomologist at Lagos, Nigeria, and one of our more recently elected AMCA members, has written a letter which may be of interest, especially to those of us who met him at the International Congresses on Tropical Medicine and Malaria last May. Excerpts from his letter follow:

"I received your letter only a few days ago on my return from the Cameroons where I have been spending some time working on an entomological survey; this was in connection with some extremely interesting work on jungle yellow fever being carried out by the Y. F. R. I." . . . "I would like to say how glad I am to become a member of the American Mosquito Control Association, and how much I look forward to receiving its most interesting and valuable publication." . . . "My short visit to the United States now seems a long way off, but remains nevertheless one of the pleasantest memories of my life. The extreme kindness and generous hospitality shown to me everywhere will not soon be forgotten. I most sincerely hope that this short stay will prove to have been merely introductory and that I shall one day have the opportunity of making a much longer visit, of really 'seeing' America thoroughly." . . .

Dr. Chwatt is at present located at the Yellow Fever Research Institute. He has promised to send an article soon for inclusion in MOSQUITO NEWS.

H. L. T.

PATRON ATTACKED BY MOSQUITO AT "COMMON GLORY." The other night, it was reported that a lady attending the showing of the "Common Glory" was bitten in the middle of her forehead by a mosquito.

The "Common Glory" is an open-air show, and the Williamsburg Mosquito Control Commission has been controlling mosquitoes there for the past two years. This was the first report of a mosquito in the amphitheater. A check revealed that on this particular night just before show-time when normally the area is fogged, it looked so much like rain that the fogging was dispensed with. However, it cleared and the show went on without the benefit of fog.

The "Skeeter"

PARTIAL DRYING OF *Culex* PUPAE. In the March, 1948, number of MOSQUITO NEWS, C. O. Masters describes some unusual experiments carried out in India which seemed to indicate that *Culex fatigans (quinquefasciatus)* does not re-

quire a water medium in order to transform from pupa to adult. Over five hundred field collected pupae were brought into the laboratory and placed on moist filter paper. Eighty-three per cent completed their development in less than a week.

In the field the same exposure to air had been observed. Soil conditions at the bottom of a breeding spot would naturally affect the ability of pupae to survive as the water drained off or evaporated. It is apparent that the caking of mud would prevent the escape of many adults.

WM. E. BICKLEY, *The "Skeeter"*

PREFLOODING TREATMENT METHOD EFFECTIVE AT CONSOLIDATED. Letter from Ted Raley, Manager of the Consolidated MAD follows:

"You may be interested in the results we've had here with preflooding treatment. Our success has been so spectacular and so positive, we're ready to go out on a limb recommending this method for *Aedes* control. Yesterday Ed Davis offered one of the operators 5 cents for every larva found in a recently flooded pasture. After very extensive dipping no money changed hands. This same field had been a headache to larvicide and results had never been perfect, a few adults always got away.

"Pretreating work was started in mid-May, in two zones. By early July we felt justified in swinging the entire *Aedes* program to this method. At this time all operators have had ample opportunity to test pretreating in every type of condition and none have reported a failure. Tested under varied field conditions by a large number of persons all agree that it does a good job, saves time and has certainly created confidence in the District employees. You can readily understand the position it put the administrative staff in, we take no excuses for *Aedes* adults in any part of the District accessible to ground equipment. The farmers like it better too, we're doing our work when the fields are dry.

"Most of this work is done with boom sprayers. We're not too satisfied with the one we're using, but it works. Tests are being made with different nozzles, but we're sticking to the short, protected boom. With our present arrangement the spray covers a 30-ft. swath, applying approximately 3½ gallons of 2 1/10% DDD or about ¾ of a pound of Technical per acre. Some DDT has been used as well as some gamma BHC. Both work well although all work with the gamma has been at about .05 lbs. to the acre. This stuff looks very, very good.

"All areas treated have held up for one flooding, some for as many as five. Another interesting observation has been that when larvae do appear they are very few in number. I've assumed this comes from a combination of factors, possible egg kill, larva kill and adult kill, both at the time of spraying and from residual action. Several reports have come in that adults have moved into pretreated fields and then disappeared. Some of these reports have come from reasonably responsible employees.*

"Now that we've taken the pressure off *Aedes* control, we're spending a lot of time trying to develop a fixed dispenser for *Culex* control in permanent ponds. We've had success with casting plaster and concentrate, but it is too soon for final results. Gamma BHC shows the most promise to date. Cesspools, ponds, ditch drops, etc., have been free of larvae for several weeks now, but we're not satisfied yet. I'm hoping for something a little more positive, that is, so much larvicide released in such and such period of time. Our present method works, but we still feel uncertain.

"Keep your fingers crossed and hope with us that next year we can be on top, right from the start. Our biggest problem now is to find enough larvae for the experimental work."

Mosquito Buzz, Aug. 15, 1948

Among the publications called to the attention of the Reviews and Abstracts Department during 1948 were:

"PYRETHRUM POST" 1(1):1–24. July 1948. Anglo French House, 2 Queen Anne's Gate, London S. W. 1, England. This is the first number of the official publication of the Pyrethrum Board of Kenya. According to the Editorial: "The *Pyrethrum Post,* now making its first appearance, is published with the object of spreading information about the use of pyrethrum as an insecticide as widely as possible." . . . "It need hardly be added that the Editor will appreciate news and views from readers who are interested in Pyrethrum."

"ACTA TROPICA, Review of Tropical Science and Tropical Medicine, issued in collaboration with eminent Swiss and foreign specialists by R. Geigy, A. Gigon, R. Speiser, and R. Tschudi, Professors at the University of Basle." Inquiries and subscriptions may be addressed to Albert J. Phiebig, Suite 906, 545 Fifth Ave., N. Y. 17, N. Y. "ACTA TROPICA" has been published in Switzerland since 1944. Articles are in English, French, or German; and short summaries in the other 2 languages are provided.

"ALAMEDA COUNTY MOSQUITO ABATEMENT DISTRICT ANNUAL REPORT 1947." 32 pp., 7 tables, 8 illus. Oakland, California. This is the 17th annual report, and was prepared under the direction of Harold Gray, Engineer and Executive Officer.

"THE DESPLAINES VALLEY MOSQUITO ABATEMENT DISTRICT, TWENTIETH ANNUAL REPORT, 1947." 31 pp., 4 figs, 5 tables. Lyons, Ill. J. Lyell Clarke, Sanitary Engineer, is responsible for this comprehensive report.

"CENTERFIELD" is a monthly news letter published jointly by the Division of Entomology,

* Editor's Note: Why not effective also prior to flooding by rainfall?

Fla., State Board of Health, and CDC Activities, at Jacksonville, Fla. J. A. Mulrennan is Director and Mrs. Nina Branch, Editor. Volume 2, No. 5, May 1948, includes: "Work of the Division of Entomology of the Florida State Board of Health," Mulrennan; "Entomological Surveys of North and West Florida Areas, April and May 1948," Taylor and Thurman; "Residual Spray Program," Ault; and reports from anti-mosquito districts. "The Drafting Board," a news and notes department by O'Shaughnessy, concludes this 36-page contribution.

"DADE COUNTY ANTI-MOSQUITO DISTRICT, 13th ANNUAL REPORT, 1947." Fred H. Stutz, Director. 12 pp. Miami, Fla.

"REPORT OF THE UNION COUNTY MOSQUITO EXTERMINATION COMMISSION FOR 1947." Ralph J. Van Derwerker, Supt.-Eng. and Secretary, 18 pp., 8 illus. Cranford, N. J.

"BOLETIN MEDICO," Departmento Médico, Creole Petroleum Corporation, Apartado 889, Caracas, Venezuela. 1(1):1–103. June 1948. (In Spanish.) This bulletin is a publication of Creole's medical department and is "of professional interest, also for industrialists and sociologists," and "subscriptions are free of charge." The Editorial Board includes Pablo Anduze, an AMCA member.

"NEW JERSEY MOSQUITO DIGEST #2." New Jersey Agric. Expt. Sta., New Brunswick, N. J. 10 pp., mimeo. Oct. 1, 1948. "The material for this Digest has been taken principally from the reports of the several mosquito commissions, and the reports of the various executives presented at the monthly meetings of the Associated Executives of Mosquito Control Work in New Jersey." The Digest opens with the above paragraph and concludes with a "General Comment" by T. D. Mulhern.

"ANOPHELES MOSQUITO ON GUAM." The Hawaii Health Messenger, 8(11):1. May 1948. A note of interest to AMCA members follows in its entirety:

"The discovery of the anopheles mosquito was reported to the Bureau of Mosquito Control recently. According to Dr. David D. Bonnet, Acting Chief of the Bureau, the species found, *Anopheles subpictus* Grassi, is considered a serious vector of malaria only in the Celebes. Surveillance work in the vicinity of airports and the waterfront in Honolulu has been carried on by the Bureau since 1945, and control measures, in the event new mosquitoes are discovered in the Territory, can be instituted immediately."

H. L. T.

PHOTOGRAPHY OF THE CONGRESSES

A News Note in the September issue of MOSQUITO NEWS described the outstanding events of the Fourth International Congresses on Tropical Medicine and Malaria held last May in Washington, D. C., but failed to mention that cameras were much in evidence at all times. We are including a few of the photographs taken; the first is a State Department picture by Marie Hansens, and the others, by our own Tommy Mulhern.

H. L. T.

1. Dr. and Mrs. F. C. Bishopp. A candid "shot" taken during the reception at the Pan-American Union, given by Asst. Sec. of State and Mrs. Thorp.
2. Dr. and Mrs. W. B. Herms leave historic Dumbarton Oaks after attending the garden party.
3. Sir Malcolm and Lady Watson pose for T. D. M.
4. Major General Sir Gordon Covell, of the United Kingdom, and Dr. John W. Field, of England and Malaya, oblige the cameraman.
5. Miss Louise Goode (standing) demonstrates the presence of sporozoites in mosquitoes to visitors at the National Institutes of Health, malaria laboratory. Seated are: Mrs. S. Jarchoe (nee Irma Seijo) and Dr. Arthur Turner of the Office of the Surgeon General, U. S. Army; and Dr. Leonard Chwatt, Medical Entomologist, Lagos, Nigeria.
6. Mr. Harry Stage's home in Virginia was the scene of an afternoon party, which included: (left to right) Dr. C. A. Alvarado, Argentine; Dr. K. K. Viswanathan, India; H. H. Stage, U. S. A.; Dr. V. Coll, Argentina; Dr. S. Sundaram, India; and Dr. C. Y. Chow, China.
7. While inspecting the insectary, visitors at the National Institutes of Health, malaria laboratory, observe the preparation of a sporozoite suspension from ground-up mosquitoes. The entomologist explains the process to: (left to right) Dr. A. L. Galvão, Dr. R. Rachou, Dr. L. Deane, Dr. A. Vargas, and Mrs. A. L. Galvão, of Brazil; and Dr. A. J. Walker, United States.
8. Major General Covell goes for a ride in the helicopter during the insect control demonstration at the U. S. Dept. of Agriculture Research Center, Beltsville, Md.

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1. Officers of the Congresses: left to right (sitting), Gen. Marcel Vaucel, Head of Typhus Service, French Colonial Health Service; Dr. Wilbur A. Sawyer, Exec. Sec., Fourth International Congresses, United States; Dr. Leonard A. Scheele, Surg. Gen., U. S. Public Health Service, Chairman, U. S. Delegation; Dr. L. Van Hoof, Inst. Trop. Med., Antwerp, Belgium; (standing), Prof. Alberto Missiroli, Inst. of Health, Italy; Prof. J. Rodhain, Honorary Director, Inst. Trop. Med., Antwerp, Chairman of Belgian Delegation; Maj. Gen. Sir Gordon Covell, Ministry of Health, Chairman of United Kingdom Delegation; Sir Malcolm Watson, London School of Hyg. and Trop. Med., England; Maj. Gen. Sir Sahib Singh Sokhey, Director, Haffkine Inst., India; Dr. Arnoldo Gabaldon, Ministry of Sanitation and Social Welfare, Venezuela.

THE AWARD of the Nobel Prize in Medicine to Dr. Paul Mueller for his discovery of the insecticidal value of DDT is not only a deserved recognition of the scientist and his work but also of entomology and its important place in veterinary and human medicine. Dr. Mueller is to receive the award at a ceremony in Stockholm, Sweden, on December 10. In addition to the signal honor attached to receipt of the Prize, the award has a monetary value of about $44,000.

Dr. Mueller is known to a number of American scientists both through the appearance of his name as the patentee of DDT, and his visit to this country in 1945 at the invitation of the United States Government along with other members of the Geigy Company with which firm he is connected.

The University of Basle granted the doctorate in chemistry in 1925 to Dr. Mueller who became associated with the Geigy Company immediately thereafter. Practically the whole world feels indebted to Dr. Mueller for the discovery of a material that is doing so much to relieve suffering, mitigate insect annoyance, and step-up production of food, feed and fiber.

F. C. BISHOPP

LOUISE GOODE, our very attractive blonde, has left the insectary at the N. I. H. in Bethesda, Md. She returned to her native South Carolina to begin work, December 6, in the chemical laboratories of the Celanese Corporation at Rock Hill. The AMCA, individually and collectively, will miss her. We wish her the best of luck

H. L. T.

DR. ARTHUR D. JAQUES of Lynbrook, Long Island, New York, initiator in 1916, and until last year a member of the Nassau County Mosquito Extermination Commission to which he is still a consultant, has received a signal honor. Proposed by the Nassau County Medical Society, he was nominated by the Medical Society of the State of New York for recognition by the American Medical Association as the year's outstanding general practitioner. Dr. Jaques began the practice of medicine at Lynbrook in 1900; and, in addition to his medical practice and his service as Mosquito Commissioner, he has been Health Officer for Rockville Centre and East Rockaway; Sanitary Supervisor of Long Island during World War I; Draft Board Consultant during World War II; Staff Member and Consultant of various hospitals; and a member and past president of various medical societies. Outside his profession, he is a Vice President of the Lynbrook National Bank, President of the Rockville Centre Savings and Loan Association, and a participant in many other civic activities.

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ASSOCIATION NEWS

THE AMERICAN MOSQUITO CONTROL ASSOCIATION, INCORPORATED

LETTER FROM THE SECRETARY-TREASURER

New Brunswick, New Jersey
December 2, 1948

Dear Dr. Glasgow:

I am sending herewith the certified documents of the Incorporation with the thought that you might want to publish them in the December MOSQUITO NEWS, with a photographic reproduction of the original certificate granted by the State of New Jersey.

The accomplishment of the incorporation marks another great milestone in the progress of the Association. The members have much to be proud of, for it has been their loyalty of purpose that has made it possible for the "mosquito people" to unite, and go forward together. In my mind a few particular events stand out in the history of this Association as highlights of its progress: First the get-together so long ago in Delaware, of the mosquito superintendents of the eastern states with you, Dr. Headlee, and Dr. Stearns, when the old Eastern Association was formed. Then the decision to undertake publication of "MOSQUITO NEWS," first a baby publication, creeping falteringly along until it began to find its feet. Then the conversion of the Eastern Association to national status, not because of any particular ambitions of the group, but because the interest of other workers from outside the immediate area engendered a sense of responsibility to their needs—a responsibility that could be met only by expanding the original organization so that it could be truly "The Association" of all mosquito workers. Then the adoption of a new constitution, which though full of faults nevertheless allowed the AMCA to begin to grow up. Now the incorporation for which you have labored so hard and so long has been effected. Now the many who are toiling to advance the AMCA to its rightful place among the scientific societies, and to improve MOSQUITO NEWS so that it too can better serve mosquito control everywhere, have another of the important tools with which to work.

But there is still much to be done. The active help of *every* member is needed. With the publication of your notice that the incorporation is at last a fact, will you not publish another appeal to our people to put their shoulders behind the several "Wheels" on which this vehicle must travel, and PUSH, in at least these three ways:

1. Help get new members. The half dozen members who comprise the Membership Committee are producing results, but they could do tremendously more with everyone helping. Can every present member get one additional new member in 1949?

2. Get advertisements for MOSQUITO NEWS. Request every member to ask his suppliers of materials and equipment to advertise with us. No other publication is so widely read among mosquito control workers. We offer advertisers serving our field the best value for their money.

3. Get more articles for MOSQUITO NEWS. Particularly short articles on specialized equipment, gadgets, procedures, and effective "tricks-of-the-trade." Maybe some of those who are doing things, but who do not like to write formal articles would "write a letter to the Editor." Don't ever forget, what is so common to one man as to be taken for granted, may be entirely unique and of immense importance and help to the next fellow, when he learns about it.

Sincerely yours,

(Signed) T. D. MULHERN,
Sec.-Treas.

Copy to Mr. H. D. Peters

CERTIFICATE OF INCORPORATION

AMERICAN MOSQUITO CONTROL ASSOCIATION

This is to certify that

Roland E. Dorer, Essex Bldg., Bank & Plume Sts., Norfolk 10, Va.

Robert D. Glasgow, State Education Bldg., Albany, N. Y.

Harold F. Gray, 1-A Court House, Oakland 7, Calif.

Willard V. King, Box 3391, Orlando, Fla.

Thomas D. Mulhern, Agricultural Experiment Sta., New Brunswick, N. J.

Travis E. McNeel, 707 Pere Marquette Bldg., New Orleans, La.

H. Duke Peters, 940 Main St., Jacksonville 1, Fla.

Don M. Rees, University of Utah, Salt Lake City, Utah

Lester W. Smith, Parsonage Road, Metuchen, N. J.

as the present national officers and governing body of the unincorporated American Mosquito Control Association, after preliminary action recommending incorporation and notice to the membership as prescribed, and by direction of the Association as voted at the last annual meeting constituting them the National Board of the Association, have associated themselves, their associates, and their successors as a corporation not for profit, under the laws of the State of New Jersey (Revised Statutes, Section 15:1–12).

The said corporation to be governed by the officers named acting as a National Board, until a set of by-laws appropriate to provide for the contemplated purposes, objectives, and activities of the corporation have been formulated by the said National Board, and accepted by the corporation.

During this interim, the said National Board shall elect from among its members a Chairman and a Secretary-Treasurer, and shall appoint such other officers and such standing and special committees as may be required to carry on the current business and activities of the corporation, as nearly as may be within the framework provided by the constitution and by-laws of the former, unincorporated American Mosquito Control Association.

Purpose: The purposes and objects of the said corporation are:

To carry on and continue the objects and purposes and functions of the unincorporated association heretofore known as the American Mosquito Control Association (a non-profit, technical, scientific, and educational association), which are stated as follows:

"To promote closer cooperation among those directly or indirectly concerned with, or interested in mosquito control and related work; to work for the highest standards of efficiency in such work; to encourage further research; to disseminate information about mosquitoes and their control; to work for understanding recognition and cooperation from public officials and from the public; to encourage the enactment of legislation providing for a sound, well balanced program of mosquito control work suited to local conditions wherever needed; to meet fairly and understandingly, and thus to disarm opposition to mosquito control work from any source; and to protect wildlife in every possible way from avoidable harm, and to encourage the use of control measures calculated to bring about the best practicable degree of adjustment where diverse interests are involved; to work for the highest degree of understanding cooperation with related organizations, to the end that the best interests of all may be most fully served; and to publish MOSQUITO NEWS as a journal of mosquito control and related work in the furtherance of these objectives."

These objectives contemplate helpful cooperation for the purpose of coordinating and promoting in accord with the public interest, the public health and related activities of member and affiliated public and private agencies and individuals concerned with or interested in mosquito control and related work; for the purpose of carrying on scientific research investigations, and of otherwise collecting for publication, scientific, statistical and other information concerning mosquito control and related work which may be helpful or otherwise of interest to such member and affiliated agencies and individuals and to the general public; for the purpose of discovering and making known the latest and best methods of carrying on mosquito control and related work, and thus for the purpose of contributing toward maintaining high standards and a high degree of efficiency in such work; and, finally for the purpose of publishing an official journal of the association, and such other publications, bulletins, circulars, and the like as may best contribute to further the expressed objectives of the corporation.

PRINCIPAL OFFICE AND REPRESENTATIVE

The principal office of the corporation shall be located at the *New Jersey Agricultural Experiment Station,* in the city of New Brunswick, New Jersey; and the agent in charge thereof on whom process may be served is *Thomas D. Mulhern,* National Secretary-Treasurer of the Association.

POWERS

In accord with the Laws of New Jersey, R.S., 15:1–4, the corporation shall have power to:

a. Have perpetual succession by its corporate name;

b. Sue and be sued, complain and defend in any court;

c. Make and use a common seal and alter the same at pleasure;

d. Choose such officers, managers and agents as the business of the corporation may require;

e. Make by-laws for the management of its property and the regulation of its affairs, which by-laws may contain provisions empowering any absent member entitled to vote at any meeting of the members of the corporation, to be represented and vote at any such meeting by proxy authorized in writing, and said by-laws may prescribe the qualifications of the proxies and the form of the written authorization, but no such written authorization shall be valid after three years from its date;

f. Contract and be contracted with;

g. Take and hold by lease, gift, purchase, grant, devise or bequest any property, real or personal, necessary or desirable for attaining the objects and carrying into effect the purposes of the corporation, subject, however, to any alteration or modification hereafter made by general law as to the amount of real and personal property to be held by the corporation;

h. Transfer and convey its real and personal property;

i. Borrow money for the purposes of the corporation and issue bonds therefor, and secure the same by mortgage, and

j. Exercise any corporate powers necessary or incidental to the exercise of the powers above enumerated.

Respectfully submitted: (In accord with R.S., 15:1–12)

(Signed) H. D. PETERS,
National President.

(Signed) THOMAS D. MULHERN,
National Secretary.

State of New Jersey

Department of State.

I, the Secretary of State of the State of New Jersey, do hereby Certify that the foregoing is a true copy of the Certificate of INCORPORATION of AMERICAN MOSQUITO CONTROL ASSOCIATION

and the endorsements thereon, as the same is taken from and compared with the original filed in my office on the thirtieth day of November, A D 1948, and now remaining on file and of record therein.

In Testimony Whereof, I have hereunto set my hand and affixed my Official Seal at Trenton, this thirtieth day of November, A.D. 1948.

Secretary of State.

EDITORIAL SECTION

THE AMERICAN MOSQUITO CONTROL ASSOCIATION, INCORPORATED

As of November 30, 1948, the AMCA has become "a body corporate," "not for profit," with powers as enumerated in the certificate of incorporation printed in the ASSOCIATION NEWS section on page 191 of this number.

On the date indicated, the Secretary-Treasurer filed copies of a *certificate of incorporation* * duly executed in accord with the laws of New Jersey, in the office of the County Clerk of Middlesex County at New Brunswick, and in the office of the Secretary of State at Trenton.

The Association is now *legally* competent to meet adequately the challenge of multiplying problems, expanding objectives, and growing responsibilities by which it is now, and will continue to be increasingly confronted.

Its administrative competence, and competence as an organization to meet this challenge effectively, will depend upon the administrative agencies and procedures that may be provided in the reorganization of its bylaws.

With its responsibility for the publication of MOSQUITO NEWS; for its new series of special bulletins; for the sound administration of a growing permanent fund; and for its various services to members and to the public, the Association has become a business of no mean proportions. A business involving burdens that the Association cannot in fairness continue to ask a few of its members to carry alone, as they have been doing altogether too long; too long, that is, for the best interests of the Association itself, however well these few members may have served it. The best interests of the Association now demand a broader base of member participation.

The Association has become a growing business that cannot be carried forward properly and safely by the "happy-go-lucky," "hit or miss," fumbling procedures that characterize so many of our ambitiously started societies and associations, too many of which have withered and fallen by the wayside, or, surviving, have too largely wasted their opportunities for valuable and needed service in a futile sequence of emergency efforts to surmount crises that, with an efficiently planned type of organization, should never have been permitted to arise.

In its current reorganization, the American Mosquito Control Association should study carefully the history of similar organizations, of which there are many, in order to avoid repeating their mistakes, and in an effort to profit from the constructive expedients by which some have managed to survive and a few have been notably successful. It might well study, also, types of corporate organization that business corporations have devised.

Having served as chairman of a committee to make such a study for the Association, it is probable that no other member has given more time and thought than has the writer to a survey of the forms of organization employed by similar Associations and Societies, and to the relative appropriateness of such forms of organization to the objectives, the special problems, and the present developmental status of the AMCA.

The AMCA has now become continent-wide, and even hemispheric or international in geographic scope. Like too many other continent-wide associations, however, it has continued to operate under a "town-

* As initiated by action of the Executive Committee at Baltimore on November 21, 1947, of which the members of the Association were duly advised; as approved by a confirming vote at the annual meeting at Fort Pierce, Florida, on March 31, 1948; and as developed (with the generous collaboration of Attorney and Counsellor, Mosquito Control Commissioner, and Association Member, Mr. M. M. Stallman) by the interim National Board there named and assigned to carry out the contemplated reorganization of the Association.

meeting" type of organization, that is entirely unsuited to provide an efficient and at the same time a truly representative medium for conducting Association affairs for a far-flung membership.

It is true that some very strong national associations appear to carry on their business affairs by vote of the often almost wholly different groups of members attending annual meetings held at meeting places geographically remote one from another. A careful examination of their history and their procedures, however, will show that such associations are really and necessarily governed by small groups of members constituting self perpetuating oligarchies. The show of democratic voting at such annual meetings has little real significance. It is interesting to observe the conscientious efforts made by some of these oligarchies to inject a larger measure of truly representative democracy into their proceedings. The town-meeting type of organization appears simply to be incompatible with representative democracy in a continent-wide association.

A few associations, however, have accomplished the introduction of representative democracy more successfully into the conduct of their affairs by introducing into the pattern of their bylaws some of the practices that appear to work effectively for business corporations with widely scattered stockholders.

It appears that continent-wide distribution of the membership, rather than number of members should be the governing consideration in any choice of alternative provisions for the efficient and truly representative organization of a National Association.

For example, several thousands of members of a New York City, or a Chicago association could all attend, participate in discussion, and vote at meetings of the town-meeting type; while, of only some hundreds of members of a continent-wide national association, relatively very few are likely to attend any one meeting, and no matter how successive meetings may be moved about, truly representative member participation can never be achieved at meetings of this type.

The first, and most important consideration appears to be provision for a policy-making National Board, large enough to be regionally representative, but small enough not to be unwieldy; probably of 8 or 9 members. The members of this National Board should each serve for more than one year, possibly for two years, with a second term permitted, in order to assure continuity of policy while providing for rotation of membership.

Such a policy-making National Board should consist of elected officers only. These might be President, First Vice President, Treasurer, and possibly 5 or 6 representative Regional Directors, who would also be Regional Vice Presidents of the Association.

National conventions might be held on alternate years, with regional meetings in the off years.

The office of President is variously handled by different associations.

By some, a new president is elected each year. By others, the president is elected for a term of two years, with re-election permitted for not more than two additional two-year terms. Commercial corporations may keep the same president as long as he is willing to serve.

The one-year president, unless he has served a prolonged and active apprenticeship, is likely to be of little value to the Association. For a self-seeking member in a back-slapping mutual admiration society, this may be acceptable. For a president earnestly desiring to do a real job, and for an Association with a real job to do, the one-year term is entirely inadequate.

For the AMCA, the position of Corporation President and Chairman of the National Board should be a real job for a hard working servant of the Association; and not a more or less empty "honor" to be passed around each year among cronies.

The President of the AMCA should be competent to speak with authority for the Association before similar organizations, and on occasion before legislative bodies or the Congress.

The President should be a spokesman for the National Board, and should announce the appointment of committees; but the members of committees should be

chosen by the policy making National Board. This would contribute toward continuity of policy, and would permit regional opinion and preference to be expressed by the Regional Directors and Vice Presidents.

Each regional director should be a resident of his region, and nominating committees should consult regional preference in naming candidates for the position of Regional Director.

To span the distance handicap, questions for consideration by appropriate bodies of the Association should be presented to members of such bodies by correspondence, with provision for voting by instructed proxy if a member should be unable to attend the meeting of the group.

Quorums should be prescribed, particularly where discussion for clarification of pending questions might seem to be required. Where clarification of an issue by discussion seems required, the competence of instructed proxies might be questioned, and only open proxies recognized.

Of major importance, also, is provision for the *appointment* of a continuing Executive Director, who would perform the duties of Secretary at meetings of the National Board and of the National Council; who would see that policies recommended by the National Board and approved by the Association are observed; who would keep the officers informed so that routine activities are carried out on schedule; and who, with the aid of appropriate committees, would make arrangements for Board and Council meetings, and for National Conventions.

Hitherto, these functions have been performed in part by the Secretary-Treasurer, largely by suggestion to other officers, and without specific assignment of authority. Perhaps this officer should be authorized to perform the functions of Executive Director at this stage in the evolution of the Association.

Several standing committees must be provided for, and assigned responsibility for the various continuing business activities of the Association, such as:

1. Committee on Publication of MOSQUITO NEWS
2. Committee on Miscellaneous Publications
3. Committee on Permanent Fund
4. Committee on Sale of Advertising Space
5. Committee on Research Projects
6. Membership Committee

Chairmen of Standing Committees sitting with the National Board for information of the latter, would constitute the National Council.

Meetings of such a National Council should precede any important action by the policy making National Board.

Some members of the Association who are also members of another association with a federation type of organization, have suggested that form of organization for the AMCA.

Where appropriate, the federation type of organization has the advantage of simplicity, and certain other advantages; but it appears best suited to an activity of uniform characteristics, the practitioners of which are already organized throughout into state or similar units, each of which may be represented by an elected delegate.

For seemingly obvious reasons, therefore, the federation type of organization does not appear to be appropriate for the AMCA, at least in its present state of development.

The membership of the AMCA even now represents a wide diversity of interests, objectives, and responsibilities. For many members, the control of pest mosquitoes is their primary responsibility. For a large section of our membership, however, both southern and foreign, the primary responsibility is malaria control. Still others are charged with various responsibilities, such as "rat and mosquito control"; control of sylvatic plague; encephalitis control; tick control; and the like. Some of our members are engineers; some are teachers; some are technical laboratory workers; some are medical men; and all with correspondingly diverse interests, objectives and activities.

Only a few states, thus far, have organized state associations, qualified to send elected representatives to participate in the activities of a national federation. A very considerable number of our members are

not yet so organized. Any reorganization of the AMCA should make adequate provision for participation in Association affairs by such unorganized members, which would be difficult with a federation type of organization.

This outline of pending AMCA organization problems is intended to set members to thinking about the new bylaws they will soon be asked to consider.

In February, 1948, each member received for his consideration prior to the 1948 annual meeting, a suggested outline for a set of bylaws.

While purposely left with several points open for further analysis, this outline presented what then seemed, in the writer's considered judgment and after prolonged study of other organizations, to provide the most practical type of organization for the AMCA in its present state of development.

At least that February outline should provide a good starting point for member consideration of AMCA organization problems.

It is hoped therefore that each member will review that February outline, and at least be ready with ideas of his own to contribute when the new bylaws are presented for action by the Association.

BUY FROM ADVERTISERS IN MOSQUITO NEWS

The American Mosquito Control Association, with its antecedent Eastern Association, is now 12 years old; and the present number completes volume 8 of MOSQUITO NEWS, official journal of the Association.

No national society or association can thrive, nor grow, nor long maintain a career of successful activity in its special field without an official journal.

Only through the medium provided by such an official journal can the members of a continent-wide association be kept informed about its activities, its changing objectives, and its growing responsibilities; or can the association bring its objectives and its services adequately to the attention of a potentially interested public.

While most of the annual dues paid into the Association treasury go into the publication of MOSQUITO NEWS, dues alone at the present rate would be quite inadequate to meet current publication costs. Yet without MOSQUITO NEWS, the American Mosquito Control Association neither could have become, nor could long remain the successful national, hemispheric, or international agency that it has become.

Advertisers in MOSQUITO NEWS also contribute a substantial share of its publication cost. Without this added contribution, Association dues would have to be materially higher.

In other words, **our advertisers help to support the Association. Members of the Association should reciprocate.**

Buy from advertisers in Mosquito News if you can. At least give them a chance to bid, or consider their products carefully whenever you contemplate a purchase.

VALEDICTORY

November 16, 1948

Mr. Thomas D. Mulhern
Secretary-Treasurer
American Mosquito Control Assn.
New Brunswick, N. J.

Dear Mr. Mulhern:

Owing to pressure of other matters associated with my approaching retirement (April 1949), I shall be obliged to terminate my service as editor of MOSQUITO NEWS with the December, 1948, number.

This will permit a new editor to begin with the first number of a new volume, and would make possible at once any change of format that might seem desirable.

Until a new editor is chosen, however, Dr. Collins (without whose able assistance I could not have carried on so long) will be glad to look after matters relating to MOSQUITO NEWS affairs here.

Very truly yours,

ROBERT D. GLASGOW,
Editor, MOSQUITO NEWS

RDG:MS

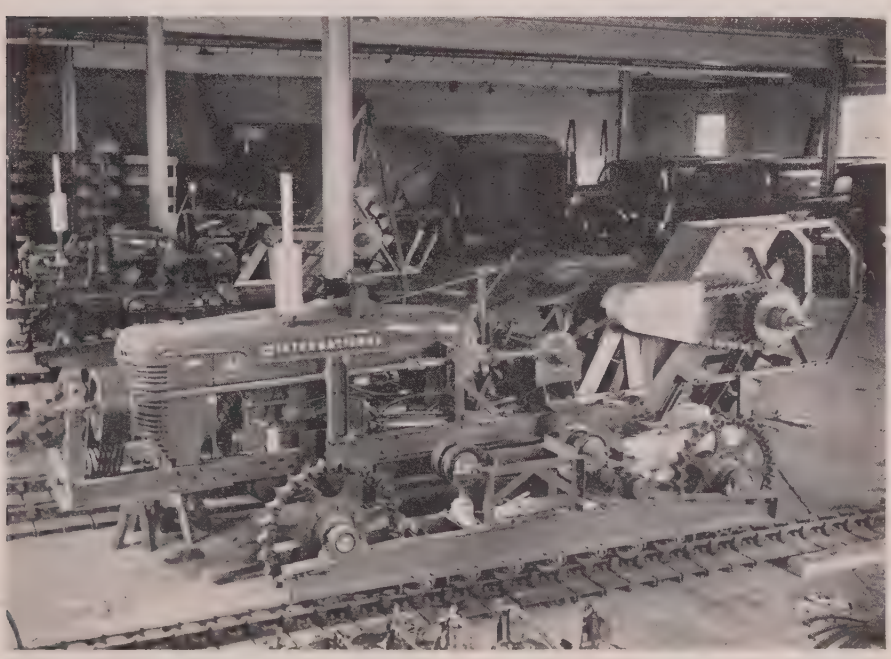
CORRESPONDENCE

EXTRACT FROM A LETTER TO THE ASSOCIATE EDITOR

Dear Helen Louise:

Busy, busy, still busy! C. T. Williamson is just completing 2 new salt marsh ditchers (about $7,500 and 7 tons each) from my plans—Cape May and Burlington Counties each want one apiece so I have to try to make arrangements for their construction and supervise it when it gets going. Ocean county wants a crawler crane on special crawlers which I must design, and Morris County (Jim Hart) wants his new hydraulic ditching hoe improved by adding two new extra features—longer crawlers, and a device to swing the digger unit while the crawlers remain stationary. Much machinery!

(Signed) T. D. Mulhern



C. T. Williamson's new ditcher now under construction.
(Chris is Director, Suffolk County Mosquito Control Commission, Long Island, N. Y.)

REVIEWS AND ABSTRACTS

THE ANOPHELINI OF THE ETHIOPIAN GEOGRAPHICAL REGION. By Botha De Meillon. Publications of the South African Inst. for Med. Res. 10(49), 272 pp., 85 plates, 2 figs. 1947. Johannesburg. Price $3.00. This is an excellent and attractive treatise on the anopheline mosquitoes of Africa. Although largely taxonomic, it contains much information on biology, distribution, breeding places, and disease relations of the Anophelini. There are 9 types of breeding places and the species found in each are listed.

The 18 species and 2 varieties of these which have been found infected with malaria in nature are given. Four additional species have been infected experimentally with malaria parasites, while 4 others are suspected of being vectors on epidemiological grounds.

Keys to the subgenera, groups, and series are followed by keys to the females, fourth stage larvae, pupae, and eggs. Detailed descriptions are furnished of the known stages of each species together with notes on biology, distribution, and relation to malaria. *Anopheles gambiae* Giles, because of its great economic importance, is treated more fully. In Ethiopia, 70 species and 21 varieties of anophelines are recognized and of these 40 are known in the egg stage.

The distribution of all of the species by countries is tabulated and the publications on the Ethiopian Anophelini are well covered in the bibliography. To those concerned with the identification of African mosquitoes, the profuse illustrations are of inestimable value. The author has done a highly commendable piece of work and is to be congratulated.—F. C. BISHOPP, Bureau of Entomology and Plant Quarantine, U. S. Dept. Agr.

REPORT OF THE NINETEENTH ANNUAL MEETING OF THE FLORIDA ANTI-MOSQUITO ASSOCIATION. 1948. Every one interested in mosquito control work will welcome the new 78-page mimeographed pamphlet which has recently come to my desk. It is the report of the Nineteenth Annual Meeting of the Florida Anti-Mosquito Association which met jointly with the American Mosquito Control Association at Fort Pierce, Florida, on March 28–31, 1948.

This meeting was one of the highlights of the year because it was held in conjunction with the annual meeting of the American Mosquito Control Association. Thus the pamphlet reports not only the most recent local activities of a State long famous for its anti-mosquito work, but also contains the report of the most recent developments and findings in this work on a nation wide scale.

There are 10 county reports of anti-mosquito activities in Florida. These reports deal with the varied and numerous problems involved in anti-mosquito operations, the kinds of mosquitoes encountered, the organization of the work, the amount, kinds, and cost of the materials and equipment so ingeniously used. Aircraft spraying appears to be a very important phase of the work in Florida. The results were uniformly gratifying to a State long famous for its fine resorts.

In the pamphlet also are 8 articles by internationally recognized authorities, who reported some of the most recent developments in this field before the meeting of the American Mosquito Control Association. Dr. Paul F. Russell, Staff Member, International Health Division of the Rockefeller Foundation, ably reviews the history of mosquito control operations and points out some of its more important next steps—particularly in the control of malaria.

Mr. George H. Bradley, Senior Entomologist of the U. S. Public Health Service at Atlanta, gives an excellent summary of the work of the Communicable Disease Center there in the Malaria Control program.

Director Harold F. Gray of Oakland gives a most interesting account of the organization and development of mosquito control activities in California, while Dr. Herbert A. Crandell gives a similar account of mosquito control work in Ohio.

The effects of DDT on fish and wildlife are discussed very illuminatingly by Dr. J. P. Linduska, Biologist of the U. S. Department of the Interior.

The Army campaign against mosquitoes in various parts of the world is well described by Major Ralph W. Bunn of the U. S. Army.

Dr. John N. Hughes, of the Entomology Section, Foreign Quarantine Division at Washington, cites interesting facts and figures relative to the importation of mosquitoes from foreign countries by aircraft. The quarantine is becoming increasingly effective.

On the whole, mosquito control has become big business in America. In an article by H. D. Peters, Director of Sanitation at Jacksonville, Florida, and President of the American Mosquito Control Association, it is shown that no less than $10,113,289.00 were spent in 1947 on mosquito control projects. "Mosquito control operations," he says, "are now definitely a part of the everyday life of a very considerable portion of the world's population."

This well edited and informative report brings us up to date on the most recent methods and materials of mosquito control in America. This writer feels that the Florida Association should be congratulated upon its progress toward the eradication of the mosquito menace and that all of us throughout the country should take courage therefrom and be spurred onward through increasing efforts toward our goal.—PERRY W. RUTH, Pres., Virginia Mosquito Control Assoc., Norfolk, Va.

(Editor's Note: A very few copies of these

Florida Proceedings are available, $1.00 per copy. Address J. A. Mulrennan, Fla. State Board of Health, P. O. Box 210, Jacksonville 1, Fla.)

Spray Tests Against Adult Mosquitoes. 1. Laboratory Spray Tests with Culicine *(Culex fatigans)* Adults by D. F. Waterhouse. 2. Spray Tests with Anopheline *(Anopheles punctulatus farauti)* Adults by D. F. Waterhouse and D. O. Atherton. Bull. No. 219, Council for Scientific and Industrial Research, 17 pp. Melbourne 1947.

Some of the information contained in this publication, of work done in 1942 and 1943 is already known and newer chemicals have come to the fore. Nevertheless this publication does contain information worthy of note.

Using a Peet-Grady chamber and procedures, these workers found that mosquitoes responded differently to various toxicants than did flies. Species differences were also encountered: *C. fatigans* was more resistant than *Aëdes aegypti, A. notoscriptus* or *A. alboannulatus*. The addition of some common activators for pyrethrum such as sesame oil, D.H.S. activator, n–isobutyl undecylenamide caused no increase in mortality of mosquitoes when they were added to pyrethrins although a Freon bomb containing pyrethrins and sesame oil gave excellent control. Combinations of DDT and pyrethrum were also effective.

In the spray tests against Anopheline adults, Waterhouse and Atherton found that initial contact with the spray particles is important since little difference was noted when comparing one minute and ten minute knock-down and mortality from DDT, pyrethrum, or mixtures of the two. After the ten minute period, sprays containing DDT may cause an additional mortality so that an 18 hour observation was considered desirable. A "standard" spray prepared and used several times per day for knock-down and killing of adults on the wing failed to affect the number of engorged and unengorged anophelines found nesting in sprayed huts and tents in the morning. It was not until the amount of DDT deposited was increased to 50 mg. per square foot that a persistent lethal effect was noticed.—Philip Granett, N. J. Agric. Expt. Sta., New Brunswick, N. J.

The Malaria Problem in Mauritius: the Bionomics of Mauritian Anophelines. W. F. Jepson, A. Moutia, and C. Courtois. Bull. Ent. Res. 38(1):177–208. 1947. 1. A sketch is given of the Malaria Control Organization in Service areas in Mauritius with a summarized history of malaria work in the Island since the first epidemic in 1865.

2. Keys to Mauritian Anophelines and their larvae with notes on their field recognition characters are followed by data on the distribution of adult Anophelines in the Colony and their relation to malaria intensity in different areas.

3. The influence of a number of environmental factors is discussed. It is concluded that temperature is an important limiting factor generally in winter and perennially in the highlands (above 1,000 ft.), but that the flushing action of heavy rains and probably the precipitation of food supply by colloidal iron moving under high rainfall conditions (over 100 in.) from ferrugineous lavas both play their part in the natural control of *A. funestus* and *A. gambiae*. The behavior of *A. gambiae* with respect to temperature is expressed by an area enclosed by two symmetrical catenary curves, that illustrate well the adverse influence on development of low temperatures normally occurring in winter on the coast and all the year round in the residential uplands above 1,000 ft. The thermal death point of *A. gambiae* larvae is about 42° C. and that of *A. funestus* 40° C. and the lower limit of larval activity is 16.5° C. *A. gambiae* develops most rapidly at an estimated temperature of about 37° C.

4. In the coastal regions *A. gambiae* possesses a marked tolerance to highly saline waters and is found commonly at the upper limit of mangrove *(Rhizophora mucronata)* where rainwater and seepages dilute the tidal water. *Paspalum vaginatum* swamp is a dangerous source of *A. gambiae*. The pH of natural breeding places varies from 7.0 to 8.6 and appears to have little influence in affecting distribution in the regions below 1,000 ft.

5. Melanism in *A. gambiae* larvae was found in nearly all lowland areas. It was unrelated to salinity but may be correlated with high temperatures.

6. A consideration of the effect of light on the breeding of Anophelines leads to the conclusion that shade alone is unlikely to be sufficient to control *A. funestus* in sluggish lowland waters. The apparent effect of shading is almost certainly due to the lowered temperature rather than to critical reduction in light intensity.

7. The flight range of Anophelines does not normally exceed 1 mile, and in the town of Port Louis, houses within ¼ mile of a large seasonal breeding area were quite free of both *A. gambiae* and *A. funestus*.

8. The cyclone of 1945 with wind velocity of nearly 100 miles per hour caused a complete disappearance of both adults and larvae for a period of 14 to 21 days.

9. The natural infectivity of *A. funestus* is in the order of 3 to 4 per cent, but locally, infections up to 25 per cent have been recorded. Infection is highest at the end of the transmission period, i.e., June to September.—Authors' Summary and Conclusions.

Proceedings of the Sixteenth Annual Conference of the California Mosquito Control Association. 1948. Edited by H. F. Gray and R. F. Peters. The Sixteenth Annual Conference of the CMCA was held at the University of

California on February 12, 1948, under the leadership of President Arthur F. Geib. The State Director of Public Health, Dr. W. L. Halverson, reported the unusual expansion of California mosquito control activity through the new subvention assistance program administered by his department.

The most recent information on the Vectors and Arthropod Reservoirs of certain of the Encephalitides was presented by Dr. W. M. Hammon. To those interested in the details of the California activities, the outline of the Objectives and Scope of the New Bureau of Vector Control by A. H. Dahl, State Dept. of Health, will be very interesting.

For the practical worker in mosquito control, the following presentations are very worthwhile:

"Fundamentals of Community Fly Control"—J. A. Rowe.

Symposium—"New Insecticides—Their Place in Mosquito Control."

Symposium—"Toxicities and Tolerances of New Insecticides."

"Introduction to Two Symposia"—M. A. Stewart.

"A Comparison of the Toxicity of DDT, TDE, and the Methoxy Analog of DDT to Several Species of Mosquitoes"—W. W. Yates.

"Some Physical Factors in the Deposition of DDT Mists as Mosquito Larvicides"—F. F. Ferguson, S. W. Simmons, and W. M. Upholt.

Symposium—"Use of Airplanes for Mosquito Control."

While the above list covers some of the very practical material presented at this Conference, there are two papers, by Prof. Wm. B. Herms and T. G. Raley, which should be read by every mosquito control worker. They are on the subject of public relations, which every mosquito control worker should be continually striving to improve. Prof. Herms has presented a list of ten general principles of any public relations program for your guidance.—RALPH J. VAN DERWERKER, Supt.-Eng., Union Co. Mosq. Ext. Comm., Cranford, N. J.

(Editor's Note: Copies of the Calif. Proceedings are available at $2.50 each from R. F. Peters, Exec. Sec., CMCA, State Dept. of Health, Berkeley, California.)

MOSQUITO FAUNA OF JAPAN AND KOREA. Part I. Mosquito Survey Data on Japan and Their Application in the Control of Mosquito-Borne Diseases, pp. 1–183, 67 figs.—Walter J. La Casse. Part II. Mosquito Fauna of Japan and Korea, pp. 1–273, 75 pls.—Walter J. La Casse and Satyu Yamaguti. Office of the Surgeon General, HQ. I Corps APO 301.

This, the most recent publication on the mosquitoes of Japan, was prepared as part of the activities of the 207th Malaria Survey Detachment in order to gather together information to be used in the control of mosquitoes and mosquito-borne diseases in Japan. The two parts of this large and valuable work are bound together to form a single bulky volume rather awkward to use beside a microscope because of the difficulty in keeping it open at the place you want. The text is typed and reproduced by a photographic process and the excellent line figures, with printed captions are reproduced in the same way. The first portion is devoted to the techniques of carrying on mosquito surveys and control operations, particularly as applied to Japan; to the biology of the Japanese species, and to the mosquito-borne diseases of Japan. These diseases are malaria, dengue fever, filariasis, and Japanese B encephalitis, and particular attention is given to the last. The 67 figures of this first part consist of photographs of breeding places and control operations, numerous tables, and some graphs, maps, and illustrations of collecting equipment. Part I seems to give all of the essential information on the mosquitoes of Japan as they occur in nature, and their relation to man. It should be noted that the statement that all the *Anopheles* reported for Japan are included is not true, since *Anopheles insulaeflorum* was reported by Ogasawara in 1939. Three other species reported from Japan, *Toxorhynchites towadensis, Aedes imprimens,* and *A. nobukonis,* are neither included nor listed in the introduction as not being included.

The second part consists of keys to the adults and larvae of the species, a discussion of the morphology to aid in the use of the keys and descriptions, and a description in detail of the adults and larvae, with a discussion of the biology for each species. The keys appear quite satisfactory for determining the species included although a strictly dichotomous key is to be preferred to one containing 3- or 4-way alternatives. The wording in couplet 7 of the *Culex* key is awkward since it could be interpreted that the two halves mean the same thing. The descriptions appear to be adequate and sufficiently complete when used in conjunction with the excellent figures. These are to be found on plates in the back of the book, two plates for each but one of the species. The first plate contains the adult female, the tarsal claws, the pupal trumpet and paddle, and the male genitalia, and the second plate is devoted to the larvae, usually with a very detailed depiction of the mouth parts. These drawings are excellent and well reproduced and are one of the most commendable features of the book. It is unfortunate that in the text *koreicus* is treated as a subspecies of *japonicus* while under the figure it is given as a valid species. Each species also has a map showing the distribution in Japan and Korea. It might have been more satisfactory to have the illustrations accompany the descriptions rather than to have them grouped in the back.

The 38 species or subspecies of mosquitoes treated include 5 *Anopheles,* 11 *Aedes,* and 17

Culex, as well as one species each for 5 other genera. A new subspecies of *Aedes (A. niveus nipponicus)* is described but no holotype was selected, and no type locality is given. *Culex (Neoculex) rubensis* is credited to Sasa and Takahashi 1948, but this is a manuscript name and the species must be credited to La Casse and Yamaguti as it is quite evident that it was the latter authors that prepared the description and made the illustrations first describing the species. Again no holotype is selected or type locality given. In an appendix to Part II a new species, *Orthopodomyia (O.) nipponica* is described. Two females and a male are designated as syntypes. It is to be hoped that the authors will select a lectotype from these in the near future. It is unfortunate that the bibliography does not include Hsiao and Bohart's "The Mosquitoes of Japan and Their Medical Importance." 1946.

This work is particularly to be commended for the biological information that it contains, and for the splendid illustrations. Undoubtedly more species will be found in the future, many more distribution records will be made, and several of the older species will be rediscovered, but it is a good preliminary work marred only by some careless taxonomic procedures.—ALAN STONE, U. S. Dept. Agriculture, Washington, D. C.

A HANDBOOK FOR THE IDENTIFICATION OF INSECTS OF MEDICAL IMPORTANCE. By John Smart with chapters on Fleas by Karl Jordan and on Arachnids by R. J. Whittick. 2nd Edition. 295 pp., 13 pl. (3 colored), 178 figs. 1948. British Mus. Nat. Hist., London. Price 20s.

For the mosquito worker in any part of the Old World this up-to-date treatise is most valuable. Major attention is devoted to the mosquitoes (more than ¼ of the pages) and of this 2/3 deals with *Anophelini.* The work is designed "to meet the need for a reliable summary guide to the recognition of all the Old World species at present known to be of importance in medicine and hygiene."

The work is made up largely of keys simplified for the use of the working medical entomologist. The use of the keys is greatly facilitated by abundant and well prepared illustrations. The keys include the sub-families of *Culicidae,* larvae, pupae, and adults; the tribes of *Culicinae,* larvae, pupae, and adults; the genera of *Culicini,* adults and 4th stage larvae; and the species of *Anophelini,* adults and larvae. The *Anopheles* are grouped according to world regions. Of particular interest and value is a list of known malaria-carrying *Anopheles* by regions, a citation of literature on distribution of *Anopheles* by regions, and tables giving the distribution of *Anopheles* species by world regions and countries.

The growth of our knowledge of mosquitoes is well exemplified by the fact that this edition lists 39 species and 7 varieties of *Anopheles* in the Australian region as compared with 26 species and 4 varieties in the first edition published in 1943. This, of course, is due to the intensive work in that area during and following World War II.

Insects other than mosquitoes and fleas are treated rather briefly and with few literature citations.

The authors and the British Museum are to be congratulated on getting out this revision so promptly and in such attractive style.—F. C. BISHOPP, B.E.P.Q., U.S.D.A.

EFFECTS OF DDT AND OTHER INSECTICIDES ON FISH AND WILDLIFE. SUMMARY OF INVESTIGATIONS DURING 1947. By Joseph P. Linduska and Eugene W. Surber. Cir. 15, Fish and Wildlife Service, U. S. Dept. of the Interior, 1948. One of the problems concerning all those engaged in the control of mosquitoes and other insect pests is to use insecticides effectually, and at the same time, without injury to beneficial forms of life. Through the efforts of the Fish and Wildlife Service cooperating with other agencies much information of value in guiding insect control operations is being obtained.

In the present excellent summary, which supplements a previous publication (Fish and Wildlife Cir. 11), much information is presented on the effects of DDT sprays on various forms of life in forests, streams, orchards and on the seashore. In large scale aerial applications of DDT-oil solution to forests in Idaho at the rate of 1 pound per acre, birds and mammals were not affected over the area as a whole. In forest spraying operations in Wyoming, the application of 5 to 7½ pounds of DDT per acre caused heavy bird damage, but strangely, fewer fish were killed than in other operations where much less DDT was used.

In extensive tests in West Virginia, stream treatment from the air with 1 pound of DDT in oil solution caused a nominal kill of fish. However, the bottom fauna was largely destroyed. Laboratory tests showed chlorinated camphene to be considerably more toxic to fish than DDT. Tetraethyl pyrophosphate, parathion and bis (p-chlorophenoxy) methane were of the same order of toxicity as DDT.

One of the most important phases of the work was with oysters. No mortality of young or adult oysters resulted from spraying the beds with 1½ pounds of DDT per acre, either as an emulsion or oil solution.

The Service advises, among other things, the use of DDT only where necessary, and for aerial applications over aquatic areas, the use of one-fifth of a pound or less per acre; if repeated treatments are necessary, cut the dosage to one-tenth pound or less. Of course, these quantities are adequate for mosquito control.—F. C. BISHOPP, U. S. Bureau of Entomology and Plant Quarantine.

MOSQUITO-CONTROL PRACTICE WITH DDT. John M. Henderson. Engineering News Record,

92:1034, June 24, 1948. This article discusses principles involved in selecting the proper method of mosquito control. Methods commented on include mosquito-proofing, DDT residual house spraying, drainage and larviciding with DDT, DDD, plain oil and Paris green. The author points out that all of these technics have a justifiable place in mosquito control with the possible exception of larviciding with plain oil or Paris green, use of which in due time should be virtually supplanted by more economical and effective materials. Tables of typical costs are presented with the footnote that they are subject to wide variation in practice.

Among factors mentioned as affecting choice of control methods are: density of human population, rapidity and degree of protection desired, and (for the mosquito), flight range, extent of breeding places and resting and biting habits. Examples are given. Methods of applying larvicides are discussed.

Mosquito-proofing is represented as still a worthwhile method of avoiding mosquito annoyance, but only at private expense. The greatest value of DDT residual house spraying is in controlling malaria in rural areas and small communities. Drainage is particularly indicated around urban areas. Drainage and larviciding in combination have greatest applicability (in competition with adulticiding) for the control of "outdoor biting" species of nuisance mosquitoes, although at times the airplane application of DDT as an adulticide over breeding places to kill newly emerged adults is indicated. DDD larvicide is preferable to DDT for breeding places possessing special wild life value.

The foreword states "When a revolutionary development occurs in any field, confusion as to its import, particularly in relation to established methods or practices often results. With the advent of DDT insecticides, such a condition now exists with regard to malaria control." The main motif of the article is to present a balanced concept of mosquito control to public officials and engineers not engaged in mosquito control activities. It is a substantial abridgment of the original manuscript but still accomplishes much of its intended purpose.—Author's Abstract.

MALARIA NO VALE DO RIO DOCE. EXPURGO DOMICILIAR COM DDT EM SUSPENSAO AGUSA. (Malaria in the Rio Doce Valley. House Spraying with DDT Aqueous Suspensions.) E. Braga, H. Maia Penido, M. Sanches Basseres, D. Bustorff, E. P. Bezerra F. and F. P. de Moura. Revista de Serviço Especial de Saúde Pública 1(3):737–776. Jan. 1948. Rio de Janeiro, Brazil. This is the first published report on large scale DDT house spraying in the control of malaria in Brazil. The Rio Doce Valley, located in the eastern-central section of the country, is about 600 kilometers long. Malaria is practically absent in its middle third, but highly endemic in the lower third, where the vectors are *Anopheles darlingi, A. albitarsis,* and *A. aquasalis,* and in the upper third, where transmission is due only to *darlingi.*

The authors' work was restricted to this last area. After a brief summary of the malaria control measures previously employed in the region, they describe their DDT house spraying program and the results obtained after the first two applications of this insecticide. An area of 1,500 square kilometers was selected, with approximately 5,000 houses and 20,000 inhabitants. The first cycle of DDT spraying was carried out between September and December 1946, and the second from January to April 1947. The operations were performed by 5 spray teams, each consisting of 2 men (one spray operator and one assistant), and all supervised by one chief inspector. Due to the lack of adequate roads in the area, transportation was entirely on foot. All inner walls of the houses were sprayed, up to the height of about 3 meters. The insecticide was a 2.5 per cent suspension of DDT. Suspension was preferred for various reasons: in the rural area concerned, most dwellings are mud huts, and transportation of the suspensive powders alone is cheaper and more feasible than that of solutions or emulsions. In the first treatment, the suspensive powder was Gesarol AK50 (Geigy Co.), Deenol 50F (du Pont de Nemours Co.) was substituted in the second cycle. Lofstrand NER–108 hand-operated sprayers were employed, either with ¼ T 8002 or Nbr. 2 flat-spray nozzles.

	1st Cycle	2nd Cycle
Number of houses sprayed	4388	4783
Per cent of houses sprayed	82.8	84.9
Daily av. no. houses sprayed per team	11.3	12.3
Av. area sprayed per house (sq. meters)	114.98	118.30
Av. DDT per house (gms.)	287.44	291.30
Av. DDT per sq. meter (gms.)	2.49	2.45
Total cost (U.S.$)	6750.00	5700.00
Av. cost per house (U.S.$)	1.55	1.17

The higher cost in the first cycle was chiefly due to the price of the DDT powders used, which was about U. S. $1.80 per kilo for Gesarol and U. S. $1.00 per kilo for Deenol.

The results obtained were very encouraging. Although no apparent decrease was observed in the larval density of *darlingi,* the adults of this species became very rare in the sprayed houses, where nearly all specimens were found dead. The authors reported that the malaria incidence dropped sharply. The highest number of malaria patients registered monthly in the malaria season of 1947 was lower than the lowest number observed during the interepidemic periods of 2 years previous to DDT spraying.

It is claimed by the authors that in the Rio Doce Valley, where the malaria season is restricted to the first 5 months of the year, no more than 2 sprayings, with a 3-month interval, are re-

quired per year. They also emphasize the feasibility of this type of anti-malaria campaign in sparsely populated rural areas of Brazil where *darlingi* is the vector.—L. M. DEANE, Special Service, Public Health, Belém, Pará, Brazil.

PUBLIC HEALTH ENGINEERING. A TEXTBOOK OF THE PRINCIPLES OF ENVIRONMENTAL SANITATION. By Earle B. Phelps and collaborating authors. New York, John Wiley & Sons, Inc., Vol. I, vii + 655 pp., 1948. $7.50. Coming after Professor Phelps' brilliantly written "Stream Sanitation," this book is in some respects a slight disappointment. It appears to be rather uneven in treatment of the subjects, and apparently, judging from this volume and the table of contents of the projected Volume II, some important sectors of sanitation may be omitted or lightly touched upon.

Volume I covers the primary subjects of air and water, including sewage. Chapters 3 to 7 inclusive deal with heating, ventilating and lighting, and are excellent. However, this is followed, as a section of Part I, by Chapter 8, dealing with insect control. It would appear to be more logical to have placed this subject, along with rodents (which are to appear in Volume II) in a separate section concerned with vector control. Sixty-two pages are devoted to insect control, of which 47 relate to mosquitoes. In view of the world wide importance of vector-transmitted diseases, a somewhat larger coverage of the subject, extending it to include such arthropods as ticks and mites, would appear to be justified. The section on mosquito control is well done within the space limitation.

The dismissal of the complex and epidemiologically difficult subject of housing in about two pages is unsatisfactory, even though special phases of the subject are considered in several chapters.

Part II of this volume deals with water and sewage, and it is here that Professor Phelps is at his best. The "biological" approach to the subject, and the unified treatment of such common subjects as sedimentation, is excellent. But it is extremely difficult to write upon such subject material without using either too much mathematics for a medical health officer, or too little for an engineer. Possibly the treatment given is a reasonable compromise for both groups of readers.

From the health department officials' viewpoint, a fuller treatment of cross-connections and back-siphonage, especially administrative measures for control, would have been helpful.

The choice of reference material is always a difficult matter, but in a book of this type an expansion of the chapter references would be advisable. A few of the references have been carelessly cited.

In spite of the inherent difficulties in writing a compendium in this field, this first volume will well repay careful study.—HAROLD F. GRAY, Alameda County Mosquito Abatement District, Oakland, Calif.

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